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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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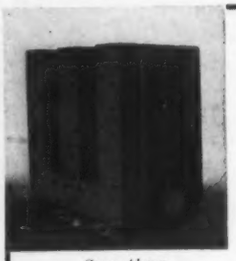

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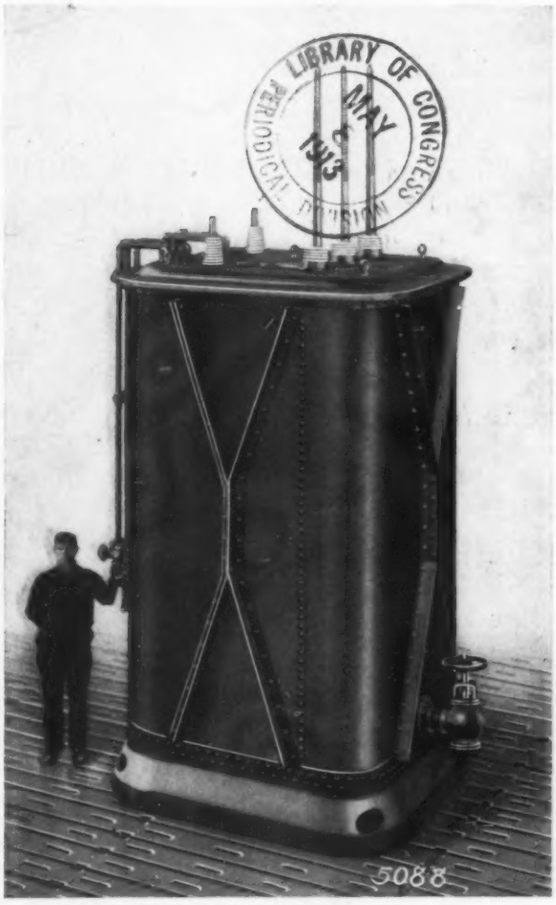

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Alphabetical Index to Advertisers, Page 8. Where to Buy It in the West, Pages, 9, 10.

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POWER AND GAS
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THE LAKE UNION AUXILIARY PLANT

BY J. D. ROSS.

Complete efficiency tests have recently been completed on the 1500 kw. auxiliary generating station of the Seattle municipal power plant. This station is interesting from the fact that it receives its water supply from the municipal water system. The plant is situated on the east shore of Lake Union, near the geographic center of Seattle, and immediately below the intermediate service reservoir of the water system, which is at the top of the high bluff overlooking the lake. The overflow from this reservoir was formerly spilled into the lake and since the reservoir is 412 ft. above the lake and the amount of overflow is approximately 60 second-feet, the power available amounts to some 1500 kw. at the switchboard.

From the reservoir a steel penstock 40 inches in diameter and 3400 ft. long carries the water to the wheel, which is of the Francis turbine type, made by the Pelton Water Wheel Company, and rated at 2500 h.p. at 380 ft. head and 720 r.p.m. The generator, direct connected, is a two-phase, 2500-volt, Westinghouse machine, and feeds directly into the main 2500 volt bus at the city substation at Seventh avenue and Yesler Way through a special tie line of 819,000 cir. mil aluminum stranded cable. Mounted on an extension of the generator shaft is a laminated fly-wheel, which is of material assistance in securing close regulation. The water wheel governor is Lombard Type P, operating in conjunction with a synchronous relief valve

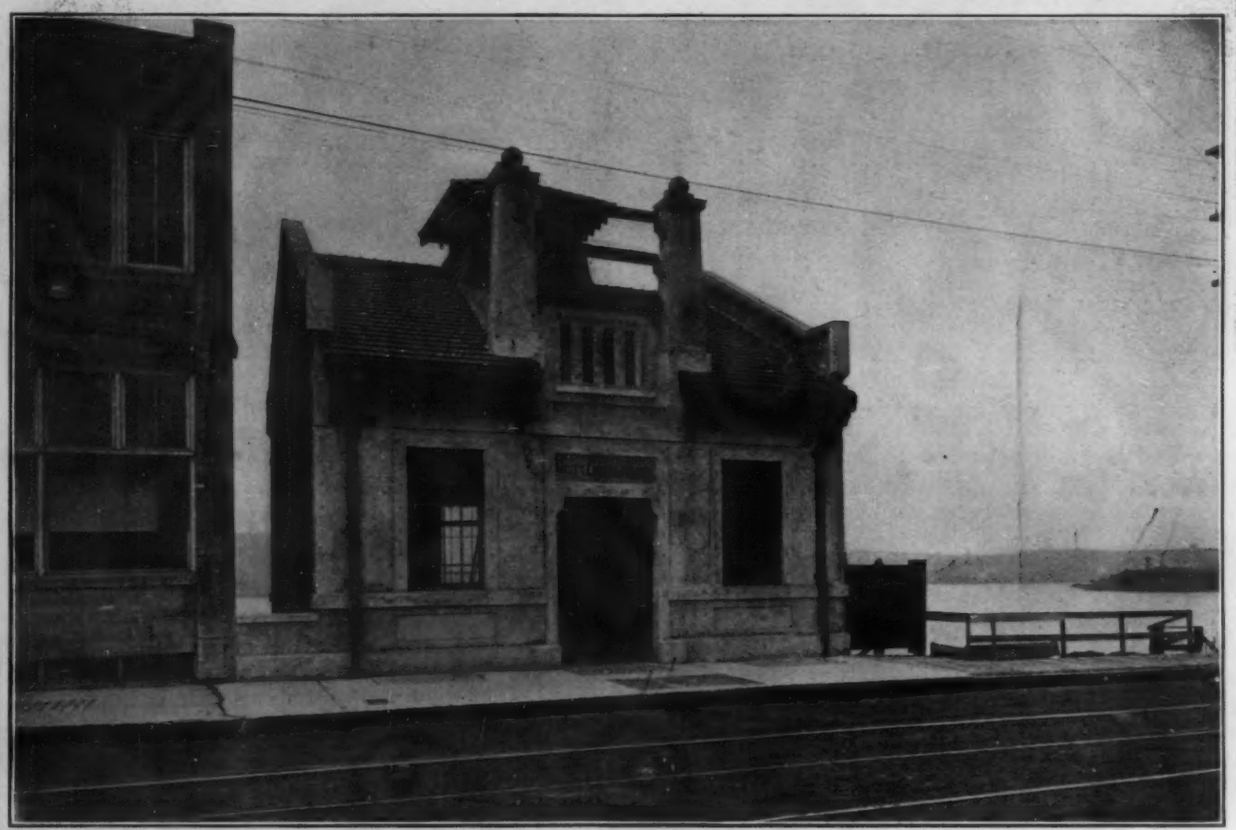


Fig. 1. Exterior View of Auxiliary at Seattle, Utilizing Waste of City's Reservoir for Domestic Waters.

on the turbine, which secures good regulation and absence of surge in the penstock even when the full load is dropped from the generator. The exciter unit consists of an overhung Pelton wheel, a 30 kw., 120-volt generator and a 220-volt, 2-phase induction motor assembled on the same shaft. The station building is

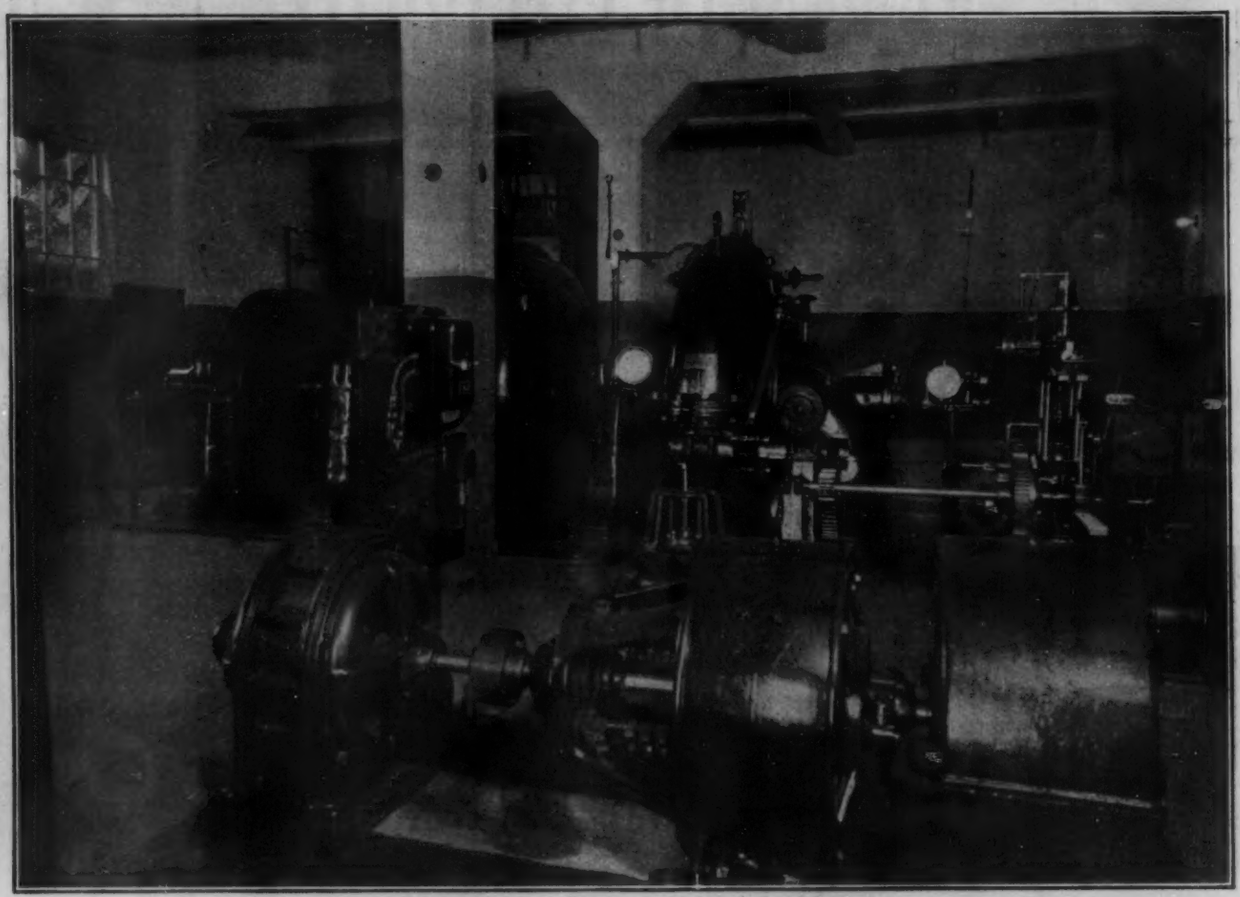


Fig 2. Interior View of the Lake Union Auxiliary.

of reinforced concrete, located on the steep bank between Eastlake avenue and the edge of the lake, with the upper floor on the street level and the lower story, which contains the machinery, a few feet above the lake level.

The efficiency tests were conducted under the direction of Dr. C. E. Magnusson of the electrical engineering department and Prof. C. W. Harris of the civil engineering department of the University of Washington. The students of the junior and senior engineering classes assisted in taking readings. The water output from the generator was measured by wattmeter, using a water rheostat for load. The rheostat consists of four sheets of No. 12 gage iron, each 4 ft. by 8 ft., stretched by strain insulators on a frame so as to be held rigidly 6½ in. apart. This rheostat was lowered into the lake by means of pulleys, and gave 1500 kw. at 2500 volts when all submerged. The accompanying curve, Fig. 3, shows the wheel efficiency obtained, which is considered excellent, considering the head on the wheel and the small linear dimensions of the runner. Care was used throughout the test to secure accuracy, instruments were calibrated before and after, and leakage from the flume accounted for.

As its name signifies, this plant was built as an auxiliary to the Cedar Falls generating station and it is held ready at all times to be put into service to carry its full capacity in case of accident to the main generating station, or to assist in carrying heavy peaks on the system. Since the peak amounts to over 8000 kw., this station is of use only to help out the larger station; bonds have been voted and plans are ready for

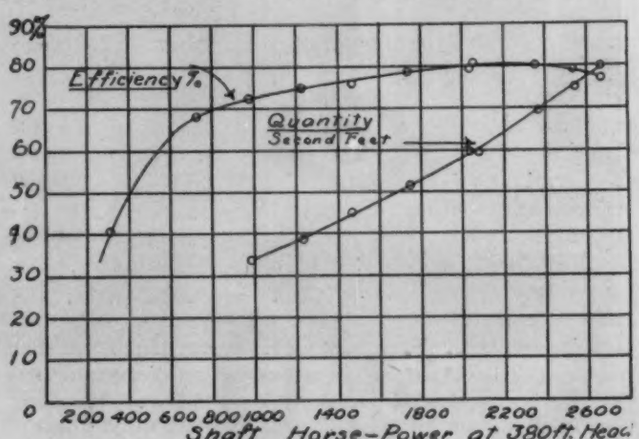


Fig. 3. Efficiency of Turbine and Quantity of Water Utilized at 380 ft. Head for Varying Horsepower at Shaft.

a 10,000 kw. steam plant to be erected immediately at the same site, in order to guarantee the continuity of the city's service.

ELECTRICAL PUMPING AND IRRIGATION

Flumes.

BY B. A. ETCHEVERRY.

Flumes are used for two purposes. The first is the conveyance of water over depressions, in which case the flume box or channel is supported by means of a substructure which may be wooden piles, a wooden or steel trestle, a concrete arch, concrete piers or reinforced concrete columns. The second is the carrying of water along steep hillsides, in which case the flume is a bench flume supported entirely or partly on a bench cut in the hill. When only partly supported on the bench it requires more or less substructure. Flumes may be classified according to the material used in forming the waterway. The following types are used:

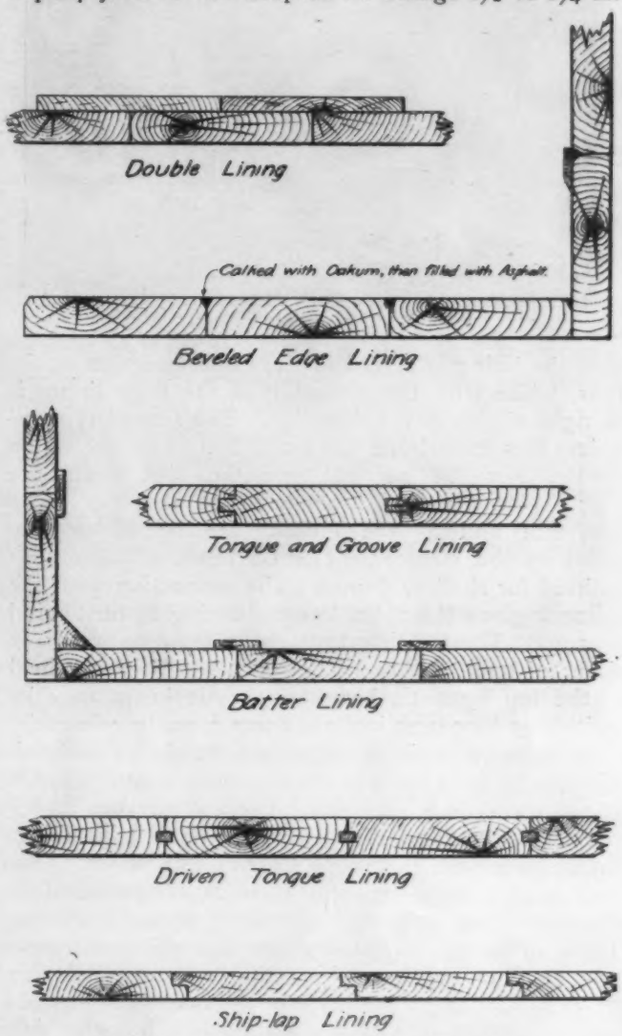
1. Wooden rectangular box flume.
2. Wooden stave, semi-circular flume.
3. Steel flumes or metal sheet flumes.
4. Reinforced concrete flume.

Wooden flumes have been extensively used ever since the beginning of irrigation. They have been used on trestle tor crossing ravines, and as bench flumes for many miles of the upper diversion lines of irrigation systems located on the steep hillsides and rocky canyons where the construction of a canal would be difficult or impossible and would be a source of danger. As long as lumber is cheap the low first cost and ease of construction make it very attractive, but the high cost of maintenance and their comparatively short life make them a large source of expense to many irrigation systems. For these reasons some of the irrigation companies are replacing their wooden bench flumes with concrete retaining walls and lining and the wooden flumes on trestle are being replaced by metal on concrete flumes and in many cases by siphons.

Rectangular Wooden Flumes.

The flume box which forms the waterway consists of the flume lining and the frame work to which the lining is nailed. The waterway is generally made with the bottom width equal to twice the depth of water and the flume lining is extended on the sides 6 in. above the full supply water level.

The flume lining should be made of well seasoned lumber free from knots. The different forms of joint lining are shown in the accompanying sketches. The butt joint lining generally leaks and requires caulking with oakum. It is generally made of 2 in. lumber. If the lumber is not well seasoned the joints will open ¼ of an in. or more. The batten joint lining is made by using 1 x 4 or 1 x 6 battens over the joints. The battens increase the cost and are liable to warp and pull away from the joints. The battens are often placed on the inside. It is preferable to place them on the outside where they do not interfere with the flow and would favor the filling of the joints with sediment. The double lining may be formed by using two layers of the same thickness or two layers of different thickness. The thickness generally used are one and two inches. It is preferable to place the thicker lining on the inside. This type of lining is extravagant in the use of lumber and not satisfactory. The tongue and groove joint is not satisfactory because of the cost of milling and the liability of the splitting of the sides of the grooves or of the tongue when the lining warps. The driven tongue lining is very satisfactory. It requires lumber at least 2 or 2½ in. thick. The grooves will be made ⅝ in. thick and ⅞ or 1 in. wide. The ship-lap joint is well adapted for linings 1½ to 1¾ in.

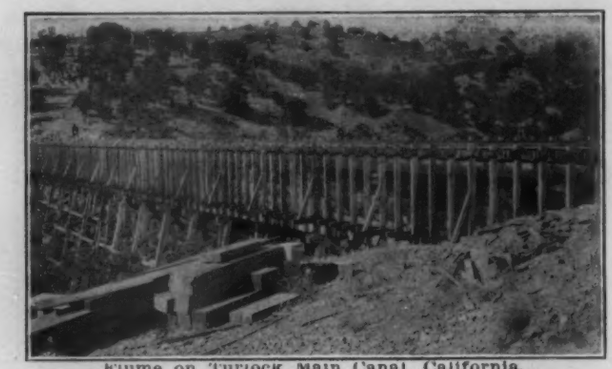


Details of Lining for Wooden Flumes.

thick. It requires from 8 to 9 per cent more lumber to allow for the lap but the cost is much less than that of a double lining and if shrinkage occurs the open joint can easily be calked.

The framework of the flume box consists of side yokes or posts to which the side lining is nailed; sills or stringers to which the floor lining is nailed; tie beams or braces to hold the side yokes in place; and a foot walk. The form of the framework depends somewhat on the substructure supporting the flume box. The substructure may be mudsills, piles and trestle. There are two standard forms of flume box depending on whether the floor lining

runs longitudinally or transversely. These are shown in the accompanying sketches. With the first type illustrated by the Delaney flume, of the Turlock main canal, California, and by the flume of the Kern River Power Company, California, the floor is nailed to sills which are connected to the side yokes. With the second type illustrated by the flume of the South Alberta Land Company, Canada, and the North Poudre Canal, Colorado, the floor is nailed to stringers. The first type is the one most commonly used. It has the advantage

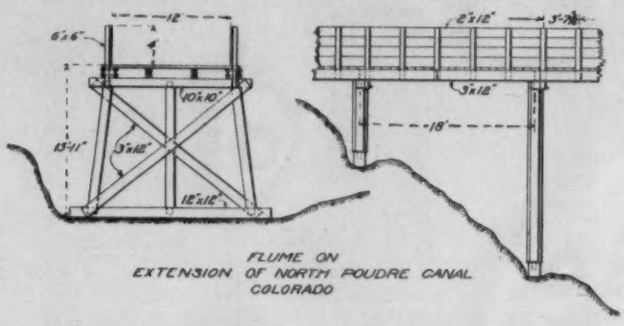


Flume on Turlock Main Canal, California.

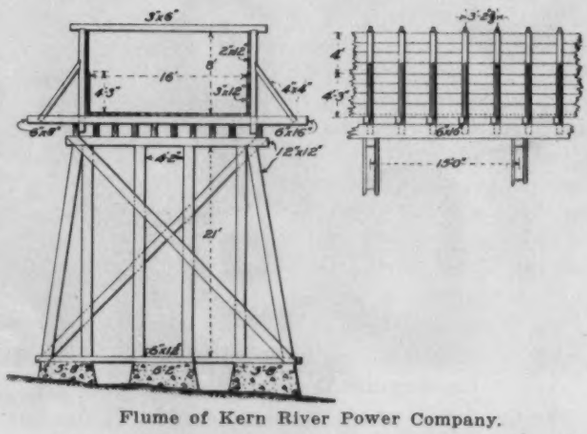
that the lining is placed in the same direction as the flow, while with the second type the floor lining is at right angles to the direction. The second type requires less material if the flume box is supported on trestle. For the second type the side posts are single pieces usually connected at the top by a tie team and at the bottom are bolted or fastened to the stringer. The tie beam is sometimes omitted for shallow flumes. The connection with the stringer gives the sides lateral bracing against wind pressure. For the first type the side posts are made either of one piece or of two pieces. They are held at the top by a tie beam or the tie beam may be omitted and for it an inclined brace extending from the floor sill to a point in the upper half may be substituted. The use of a tie beam is usually more economical for flumes up to 20 ft. in width. The use of cross braces gives greater stiffness. It is customary, especially for flumes on trestle, to provide some cross bracing. This is done by placing inclined braces at every second or fourth post, or only at each trestle bent. Sufficient lateral stiffness for a flume of this type when on trestle may be obtained by making the side posts of two pieces extending on each side of the floor sill and resting against the side of the stringer. When the side post is made of one piece it is usually of the same thickness as the floor sill and toe-nailed to it, and if there is any likelihood of the flooring settling away from the posts and sides, straps of steel should be bolted to each post and to the sill on which it rests. To tighten the joints in the side lining it may be desirable to provide for wedges between the tie beam and the upper edge of the lining.

The substructure is usually one of the following types: mudsills, piles, posts on concrete footings, wooden trestle on concrete footings, wooden trusses. In a few cases steel trestle and trusses have been used. Mudsills are used for bench flumes. They are usually made of 2 in. x 12 in. or 3 x 12 planks laid directly on the ground. If the floor lining is placed longitudinally, the floor sills are transversal and the mudsills on which the floor sills rest are placed longitudinally. For small flumes two rows of mudsills are needed; for larger flumes three or more rows. For flumes of the second type the mudsills are placed transversally.

Piles or posts are used when the flume is entirely above ground or when the flume is partly supported on a bench. Posts are preferable to piles because of the early decay of piles at the ground surface. For flumes placed on a sharp curve it is advisable to anchor with drift bolts or otherwise to the side hill. A flume supported on posts requires two or more posts to each bent and the design is similar to trestle except that the posts are shorter and no lateral bracing is necessary.



FLUME ON EXTENSION OF NORTH POUDRE CANAL COLORADO



Flume of Kern River Power Company.

A trestle consists of frames or bents spaced at regular intervals on which the flume box is supported. Wooden trestles are of the same type as the ordinary railroad trestle. For small flumes the trestle bent is formed with two inclined supports. For larger flumes three or more supports are necessary. A one-story trestle bent consists of two or more posts connected at the top with a cap and at the bottom with a sill with the necessary sway braces and sash braces. The height from cap to sill is generally under 25 ft.; for greater heights the trestle must be formed of two or more stories bent. The bents except in narrow canyons must be braced with longitudinal bracing. The bents should be supported on concrete footings. The footings must extend to solid rock or must be made sufficiently large to give a low bearing pressure on the foundation which is liable to become very soft from the leakage of the flume. The bearing pressure on soft ground should be not greater than 1 ton per sq. ft. The concrete footing should be connected to the sill of the bent with bolts so as to add weight to the structure in preventing overturning. The flume box is supported on the caps by means of stringers. The length of stringers or span between bents usually varies from 12 ft.to 18 ft.

THE PRACTICAL APPLICATION OF THE SELF-ADJUSTING STANDARD FOR RATE FIXING.

BY F. K. BLUE.

(Concluded.)

The previously estimated amount of sales during the fifth year, Q, is found by extrapolating a value based on the actual average sales during the previous four years. It is by no means necessary that the quantity thus estimated should be a close approximation to the actual amount finally sold during the year, because any undue losses or gains resulting from the price for the year being fixed too high or too low will be fully adjusted between the producer and the consumer by amortization during the following years. The chief desiderata in such adjustments are that the prices shall not fluctuate violently and that the consumers of one year are not unduly favored or burdened at the advantage or expense of the consumers of other years. Over a term of years the economic relations between the investors and the consumers are adjusted with striking accuracy by this method of rate fixing, but an adjustment of costs to the consumers of each year cannot be carried out with great accuracy since that would require an exact foreknowledge of uncontrollable conditions and events. The best results in this direction seem to be attained by conceiving a straight line to be drawn through a group of points plotted to represent the values for the previous years, by the method of least squares, and then taking the value indicated by the point on this line for the last year of the group as the estimated value of the quantity that will be sold during the following year. Such values are computed in the following manner:

Let Q_8 be the estimated quantity sold during the eighth year, and q_1, q_2, q_3 and q_4 be the actual quantities that were sold during the previous four years. Then for a value based on the actual values of the three previous years we will have $Q_8 = \frac{5q_1 + 2q_2 - q_3}{6}$

For the value based on the actual values of the four previous years we will have $Q_8 = \frac{7q_1 + 4q_2 + q_3 - 2q_4}{10}$

In the illustration the estimated quantity to be sold in the fifth year, $Q = 49.5$ million cu. ft., is computed in this manner from the actual quantities 50, 40, 29, and 22 million cu. ft. sold during the four previous years.

In the same manner the estimated unit cost of operation, $U = \$0.92$ per thousand cu. ft., is computed from the actual unit costs of operation \$0.96, \$1.18, \$1.42 and \$1.82 for the four previous years, and all the other values of Q and U are computed in the same manner from the actual values of q and u for the four preceding years in each instance.

The estimated cost of operation, C, is found by taking the product of the estimated unit cost of operation, U, and the estimated quantity sold Q. It is \$45,500 in the fifth year.

The estimated gross earnings required during the year, E, is the estimated required net earnings, D, plus the estimated cost of operation, C, plus the estimated required interest on outstanding bonds, plus the estimated required dividends on preferred stock, plus the sum to be set aside during the year in the depreciation fund. Preferred stock is understood to be that which is preferred as to a guaranteed dividend rate and not participating further in the profits of the enterprise. Only the net earnings and the cost of operation are accounted for in the illustration in order to avoid unnecessary complication in dealing with such other quantities that are not essential to the working out of the rate fixing method.

The estimated required price for the year is found by dividing the estimated required total gross earnings, E, by the estimated quantity sold, Q. This will be $P = E \div Q = \$1.21$ per thousand cu. ft. This indicated price being less than the preliminary price of \$1.35 is taken as the actual price to be charged for gas during the year since the gain g′ for the preceding year is a positive quantity.

At the end of the year it is found that the quantity sold is 54,000,000 cu. ft. Multiplying this by the actual price we have $e = pq = \$65,300$ as the actual gross earnings during the year.

The actual cost of operation during the year is found to be \$50,000. Dividing this by the actual quantity sold we have $u = c \div q = \$0.93$ per thousand cu. ft. as the unit cost of operation.

The average value of the stock during the year is \$200,000. Dividing the indicated required dividend by this stock valuation we have $r = d \div v = 0.06$, or 6 per cent as the acceptable dividend rate on the investment as indicated by the market value of the stock.

Multiplying this by the amount of the investment for the year, we have $d' = ri = \$12,000$, as the required net earnings indicated by the market value of the stock.

In computing the gain, or loss, for the year to be amortized by an allowance in the price fixed in the following years, the cost of operation is computed from a unit cost based on the unit cost in previous years instead of the actual cost being taken. This is done in order that improvements in operation and management which result in reducing the costs of operation shall increase the returns received by the stockholders, and, on the other hand, an increase in the unit cost of production will reduce the actual income of the stockholders. This is shown in the table by a comparison of the unit cost, u, and g′, the excess of actual earnings above that indicated by the market value of the stock as an acceptable return to the stockholders on their investment during the year. It will be noted that with but two exceptions a reduction in the unit cost of operation is accompanied by a surplus in the actual earnings of the stockholders and vice versa. The commensurate cost of operation, C′, is accordingly computed by taking the product of the estimated unit cost of operation and the actual quantity sold; so we have $C' = Uq = \$49,700$ for the fifth year.

The total gross earnings at estimated unit cost of operation, E′, is equal to this cost of production C′ added to the required net earnings on investment, d′, indicated by the market price of stock. So we

have the total earnings at estimated cost of operation, $E' = d' + C' = \$61,700$. As in the case of the previously estimated gross earnings, E, the estimated gross earnings, E', should in practice also include interest and dividends on bonds and preferred stock and the sum set aside in the depreciation fund, but in this case also, these items are omitted in the illustration.

The estimated excess of actual earnings above the estimated earnings based on unit cost of operation, $G' = e - E' = +\$3,600$ in the fifth year. This amount being a positive quantity represents a surplus which being subtracted from the previous deficit of $33,600 makes a total estimated deficit of $30,000 at the end of the fifth year. After the ninth year one-half of this estimated surplus, or deficit, is taken as the value of G in estimating the price for the following years:

The values e', g', s' and p' for the fifth year and thereafter are found in the same manner as already described for the first four years.

For the sixth year and thereafter the same general method of computation is followed as in the fifth year. The actual price p is taken equal to the estimated price P except that when the gain G' for the preceding year is negative the price may not be less than that of the previous year, and when the value of G' is positive the price may not be higher than that of the preceding year. This rule is not necessary but it reduces somewhat the fluctuations in price from year to year. In the seventh year it will be noted that the estimated price was computed as $1.22, but $26,000, the value of G' for the preceding year being positive, the price is kept at $1.16 as in the preceding year instead of being increased to the estimated value of $1.22. In the ninth, tenth, eleventh, twenty-sixth, twenty-ninth and thirty-first years the price is not raised to the computed amount for the same reason. In the twenty-second year the price is not reduced to the estimated value $1.01 because—$1,400, the value of G' for the preceding year, is a negative quantity. The price is not reduced to the estimated value in the twenty-fifth year for the same reason.

After the deferred dividends have been paid, which occurs at about the fourteenth year, it will be seen that under average conditions that are assumed, up to the twenty-sixth year the estimated accumulated surplus S' does not vary considerably from zero. Momentary variations caused by fluctuations in sales of operative costs are quickly liquidated by the system of perpetual amortization in price fixing. And even the persistent deficit that occurs after the twenty-sixth year would disappear if the adverse changes were halted for a year or two.

The fact that the estimated accumulated surplus or deficit S' tends always to disappear shows that on the average the economic relations between the corporation and the consumer are exactly adjusted by this method of rate fixing.

The actual accumulated surplus s' constantly increases with a constant reduction in operating costs and constantly decreases with a constant increase in operating costs, which affords the stockholders a reward for low prices and protects the consumer against excessive prices.

At the end of the twenty-sixth year it is found the price for the following year will be so high that the sales and earnings will become so small that there is apt to be a considerable deficit, g', in the actual dividend received. If this condition appears likely to continue, the investment should then be liquidated before any greater losses occur. This would be done by selling the physical property as junk or otherwise and distributing the proceeds including the depreciation fund to the stockholders. The depreciation fund should of course have been kept up so that the whole amount distributed would be just the value of the original investment of $200,000. To be exact this value should be adjusted to conform to changes in the real value of the monetary unit by which the value of the investment was originally measured; that is, except in the case of real estate, the value of the investment should conform to the cost of reproduction rather than to the original cost of the properties which it represents.

The illustration has been continued beyond the point at which a liquidation or reorganization should be effected, in order to show how the method would work in the case of increasing costs of operation and reduced sales. In practice, however, an enterprise would seldom be carried that far under such conditions.

Extensions to the plant, if adding considerably to its value, should be made by the issue of bonds or of new stock, for which there is a corresponding addition to investment valuation. Small extensions and betterments may be made by using the depreciation fund provided the physical value of the plant plus the depreciation fund be maintained equal to the value of the investment, i, which forms the basis for rate fixing.

Application of This Method of Price Fixing.

For simplicity this illustration was taken as applied to a single commodity, but with obvious modifications it can be adapted to most any enterprise in which stock can be held always for sale to the general public. It is especially applicable to the development of government resources and public utilities. Where the price of several or many articles is involved instead of one, a system of index numbers would take the place of a single price, but the method of fixing such index numbers by which the individual prices would be adjusted would be essentially the same as shown in the illustration.

Next to its use in connection with the public utilities the most important application of this method at first would perhaps be in the development of coal mines and power resources on government reservations. A grant could be made to an operating company under the stipulations that the price of all coal mined should be fixed by a government commission in accordance with this method. Any allowance for rental of lands that might be considered desirable would be added to the required earnings E, E' and e', just as if it were interest on bonds. By this method the operating company would be assured an acceptable return on its investment, and the consumer would have coal at a reasonable cost of production. There would be no risk of the government granting valuable

privileges without compensation, nor would there be a risk of government regulation which would reduce the profits below the amount acceptable to the operating company as indicated by the rate of profit that purchasers of the stock are willing to risk their money in the enterprise for.

The granting of water rights would be carried out on the same principles. An operating company would be formed to furnish the necessary capital to develop power and deliver it to customers. Such investment would form the basis on which the government would fix the price for such power. An acceptable profit on the investment would be assured since the price for any year would be fixed at a rate that would allow a dividend on the investment which would correspond to the return on the investment required by the public as indicated by the market value of the stock during the preceding year.

If it is not desirable to have the price of service fluctuate every year—as in the case of street railways—a nominal price, p, might be computed, which multiplied by the number of fares, q, would show the nominal earnings, e, which would be used in paying expenses and dividends and computing values for price fixing just as if it were actual earnings. The difference between the actual earnings and the nominal earnings would then be set aside to the credit of the municipality for the final purchase of the railway or for other purposes as desired.

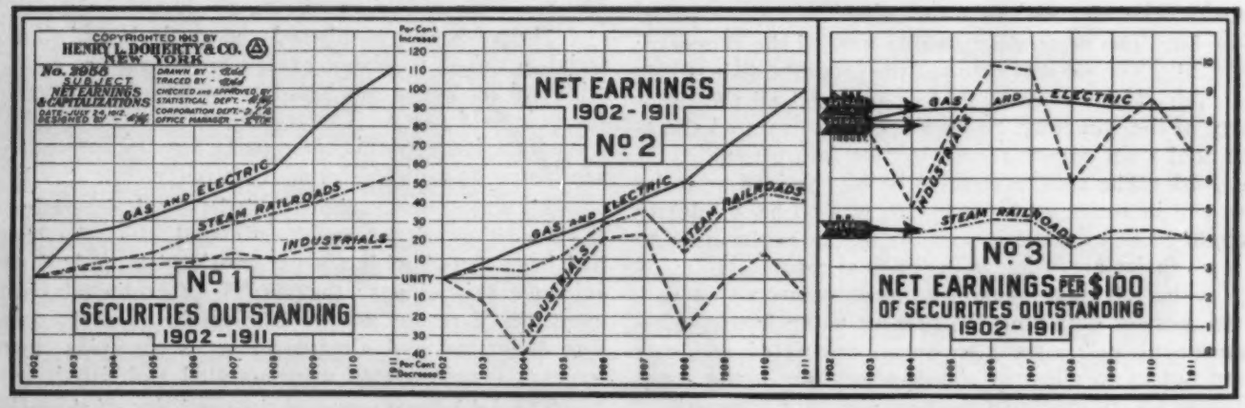
GAS AND ELECTRIC SECURITIES.

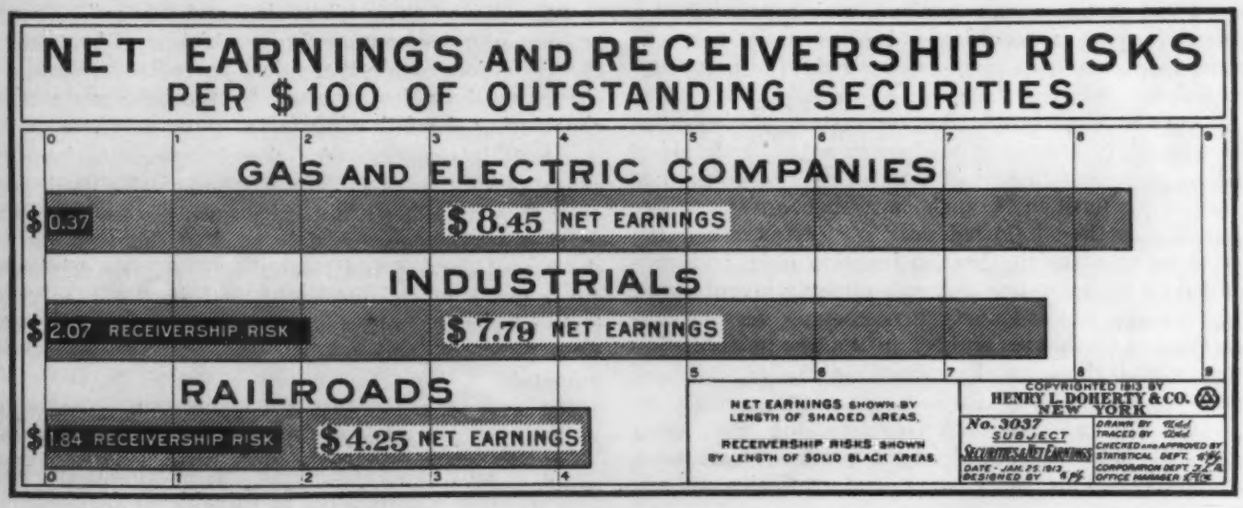
The intrinsic merits of gas and electric securities as compared with railroads and industrials is graphically illustrated in the accompanying charts prepared by Henry L. Doherty & Co.

No. 1 shows the relative increases in securities outstanding of important gas and electric, steam railroad and "industrial" companies, the figures for which were aavilable as far back as 1902.

No. 2 shows the relative increases and decreases of the net earnings of these same companies. No. 3 shows the net earnings per $100 of securities outstanding for these same groups of companies, year by year, and averaged for the 10 years. During that time they have never dropped below 8 per cent on the securities issued, in spite of the fact that these latter have increased by 110 per cent, or double the railroad expansion, is, of great interest to investors.

The remaining chart shows the average net earnings as determined from No. 3, and the average receivership risks, and illustrates the relative risks to capital. Therein it appears that for every $100 of railroad securities outstanding $1.84 averaged to be in receivers' hands. For the larger industrials this figure appears as $2.07, whereas for gas and electric securities outstanding it is but 37 cents, and this in spite of the high net earnings of these latter, amounting to an average of $8.45 per $100.




NET EARNINGS AND RECEIVERSHIP RISKS
PER $100 OF OUTSTANDING SECURITIES.
GAS AND ELECTRIC COMPANIES
$0.37
$8.45 NET EARNINGS
INDUSTRIALS
$2.07 RECEIVERSHIP RISK
$7.79 NET EARNINGS
RAILROADS
$1.84 RECEIVERSHIP RISK
$4.25 NET EARNINGS
NET EARNINGS SHOWN BY LENGTH OF SHADED AREAS.
RECEIVERSHIP RISKS SHOWN BY LENGTH OF SOLID BLACK AREAS.
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DESCRIPTION OF AN INVENTORY AND VALUATION OF A GAS AND ELECTRIC PLANT.[1]

BY H. W. CROZIER.

This paper has been prepared to describe some of the methods used in making an inventory of the gas and electric distribution systems of a company doing business in a Western city of about nine thousand inhabitants. The inventory was ordered by the State Public Utility Commission which was occupied in considering a complaint involving service and rates. Two engineers, one appointed by the commission and the other by the company, were charged with the duty of preparing the valuation.

In many of the valuations heretofore made, the quantities have been ascertained and the unit values applied directly to the original notes and the result obtained in dollars. This has been done in numerous cases where the parties making the inventory were the final authority as to the figures. In this case, however, it was expected that the valuation would be reviewed by the commission, if it should so desire or in the event that the two engineers were unable to agree.

For this reason no unit prices were applied except to the totals of the inventory and the condition of the property was reported as a percentage of its replacement value new. If any question as to the method or premises used in obtaining these percentages, corrections could then be applied in a simple manner.

Objects to be attained: The objects to be attained in the inventory and valuation were:

1st. The replacement value new of the property;

2d. The present value of the property as it stood:

3d. Maps were to be prepared and all the property of the company, as far as possible, entered thereon, and a permanent record left for future use.

4th. The results were to be so obtained as to be proven in court, and every step was to be so clearly arranged as to make it possible for an explanation to be given for every figure in the final result.

5th. All figures used for unit values or as percentages for obtaining the present value from the replacement value, were to be so calculated and carried out as to allow of simple alteration in the event that any particular item was successfully attacked.

Field parties were organized, each consisting of a chief of party, a recorder and some assistants. In some cases, one man served as both chief of party and recorder.

On the electric distribution system, the first inventory party started at the power house, and taking a line of poles followed it, numbering the poles consecutively, until a branch was encountered. The branch was then followed until completed, when the party returned to the branch junction pole, and continued on the main line. A second party inventorying copper wire, a third party inventorying service connections to the houses and a fourth party inventorying meters and checking the preceding parties, followed the same general route.

On the gas distribution system, the first party, was provided with a list of the gas consumers, arranged by streets. This party went systematically up one street and down another, inventorying gas services and gas meters, and having men whose duty it was to skirmish around houses not on the list and look for lost and capped services. The company's gas main map was carried by this party and frequently consulted.

Following the first party was a second party which listed the gas mains. A third party excavated at street intersections to determine depths, to check the company's gas map and to determine the condition of the gas mains. Except for the omission of some recent work, the company's gas map was found to be substantially correct.

The inventory parties made field notes on ruled sheets, which they numbered consecutively. These sheets were turned into the office and the data entered on a drawing for the purposes of record and as a check. The sheets were then turned over to a clerical force, totalled, summarized, and later bound as a permanent record.

Summary sheets were prepared and used to tabulate the summarized data of the field sheets and an entry was made on the summary sheets for each field sheet. Finally the summary sheets were totalled and the results transferred to the sheets bound in the final report.

The method used makes it possible to trace any item back from the final result to the original entry in the field sheet and thence to the actual property, or to trace any piece of property through the field notes and summary sheets to its location in the final result.

The poles were numbered consecutively and all material attached to them, except transformers, copper wire and arc lamps was listed in the pole field notes by the pole field party. The transformers were listed on a separate form by this same party but the copper and arc lamps were listed by another party.

All poles were examined, their length determined, the condition of the wood estimated after the butts had been tested with a prospector's pick, and, if any evidence existed near the surface of crude oil treatment, that fact was noted. The condition of the paint was estimated and all cross-arms, steps, pins, insulators, guy-wires, etc., were counted and listed.

The field party reported the condition of the poles as "Excellent," "Good," "Fair," and "Poor." To get at an average percentage figure which would represent the condition of all the poles, percentages were assigned to the poles reported by the field party after considering the following facts:

1. It is customary for electric companies to purchase as long poles as can be economically used, and, after they have been in service until the underground portion will no longer safely support them, to cut off the rotted portion and reset them. A pole originally 40 ft. long when purchased will be used successively as a 40 ft. pole, as a 35 ft. pole, as a 30 ft. pole as a 25 ft. pole and finally outlive its usefulness as a guy-stub.

2. Continuous re-use of poles is made particularly easy by the favorable dry climate in this vicinity.

3. A pole in service, therefore, which has the butt entirely gone is considered as valuable to the company as a new pole five feet shorter.

[1]Paper presented before San Francisco Section, A. I. E. E., March 28, 1913.

Poles cost here f.o.b., as follows:

35-foot poles,	$ 8.25	82% of next larger size
40-foot poles,	10.00	75% of next larger size
45-foot poles,	13.25	87% of next larger size
50-foot poles,	15.25	90% of next larger size
55-foot poles,	17.00	

Average.....84%

Making a small allowance for contingencies, 80 per cent of the original value was taken as the value of a pole the butt of which was so rotten as to require resetting. The pole condition was therefore rated as follows:

Field party's report,	"Excellent"	"Good"	"Fair"	"Poor"
Percentage used,	100%	95%	90%	85%

and if ready to fall down, 80 per cent (none so found.)

After the inventory was completed and the unit values were being applied to obtain the valuation, it was decided that the figure of 80 per cent used for the worst condition of a pole was too high, as sufficient allowance had not been made for the deterioration of the out-of-ground portion of the pole due to checking, pole climbing, etc., and it was decided to allow about 10 per cent for this. The deduction of about 10 per cent from the average 84 per cent reduced the final percentage from 80 to 75 per cent. It was then a very simple calculation by proportion, to change the percentages as reported in the inventory from the basis of 80 per cent to that of 75 per cent.

Painting: In working up the field notes as to condition of paint on painted poles, the following percentages were arbitrarily taken:

Field party's report,	"Excellent"	"Good"	"Fair"	"Poor"
Percentage used,	100%	75%	50%	25%

Other Materials: The cross-arms, pins, guy-wires and other attachments were found to be in very good condition. No attempt was made, therefore, to assign any percentage condition to any of these items.

Oiled Butts: It is customary in many parts of the West to pour crude oil in the holes when setting poles. The oil mixes with the earth and gravel and forms a very efficient protection for the wood. The pole inventory party dug at the base of every pole and noted the fact in their notes when oil was in evidence. The information obtained was not conclusive, however, as undoubtedly many poles, which were originally oiled, now show no evidence of that fact near the surface.

A copper inventory party listed the copper line wire, obtained its length by measuring on the ground pole to pole, and its diameter by measuring with a pair of calipers and a wire gauge. The pole numbers were recorded on the notes turned in so that it is possible to trace back any measurement from the notes to the actual wire in place.

The weather-proof wire was examined and its condition recorded. This party recorded the condition of the wire as follows: "New," "Good," "Frayed," "Badly Frayed," and "Bare." In addition it reported wire which had been originally put up as bare wire, as bare wire only.

In working up the notes each sheet was totalled and the length of each size of wire found. Percentages were then assigned to the reported condition and an average for the sheet obtained. To facilitate computation the product obtained by multiplying the length of a wire by its percentage was called the computation factor. Later in getting the average percentage of the summary sheets it was only necessary to add all the computation factors and divide by the length of the wire to obtain the average condition of all the wire under consideration.

The percentages used were based on the following facts:

1. Triple-braid weather-proof copper wire costs the same per pound as bare copper wire for all of the sizes above No. 10 wire.

2. When weather-proof insulation on copper wire has entirely disappeared there still remains the bare copper wire, which is as valuable to the company as new bare copper wire, because it can be used in places where bare copper wire would ordinarily be used.

3. It has been customary on this property to install new weather-proof wire on 2000-volt primary circuits. When this wire has deteriorated, so that it is no longer desirable to use it on the primary circuits, it is then transferred from the primary to the secondary circuits on the same poles. After putting in another period of usefulness as secondary wire, it is then taken down and used as bare wire on the outlying pumping circuits where insulated wire is not required.

Under these circumstances the total deterioration of the insulated copper wire is only from its value as new wire to the value of bare wire.

The sizes, weights per 1000 ft. and percentages used are as follows:

Size.	Wt. per 1000 ft. Weather proof.	Wt. per 1000 ft. Bare.	New.	Good.	Frayed.	Badly Frayed.	Bare.
4/0	767	639	100%	97%	93%	89%	83%
3/0	630	507	100	96	91	86	80
2/0	502	402	100	96	91	86	80
1/0	407	319	100	95	90	84	78
No. 1	316	253	100	96	91	86	80
No. 2	260	201	100	95	89	83	77
No. 4	164	126	100	95	89	83	77
No. 6	112	79	100	93	86	78	70
No. 8	75	50	100	92	84	76	67
No. 10	53	31	1000	90	80	69	58

In making the inventory, no allowance was made for sag, tie-wires, waste, losses, etc., but this allowance was made in the estimation of the proper unit value to be applied to each size of wire.

A service party followed the pole inventory party and listed the service connections from the poles to the houses. The notes made covered the condition, size and length of the wire and the number of the fixtures. In each case the pole number was noted so as to guard against omissions or duplications. In addition the party noted the arc-lamps and the wire and fixtures connected therewith. The notes turned in were turned over to the meter inventory party and the meters and fixtures inside the houses added by that party.

An electric meter party listed all the electric meters, noting the name of the maker, the size and the serial number, and also listed the copper wire and fixtures inside the houses and entered the data on the field sheets of the service party. The result aimed at was to list all the wire, fixtures, etc., up to and including the meters. This party, when necessary, turned in supplementary notes when more than one meter was found in a building and the field party had not left sufficient space on the notes.

In the office the notes turned in were totalled and the percentages assigned to the wire in the same manner as was done for the line wire. All the various fuse blocks, switches, conduit, etc., were tabulated and the meters tabulated as to maker and capacity.

A gas meter and service party visited all premises which had gas connections, and listed the meter,

noting the name of the maker, the size and the serial number; listed all pipe and fittings visible and made an estimate of the necessary pipe and fittings required to make the connection to the street mains. As in the electrical case, the result aimed at was a list of all pipe and fittings up to and including the meter.

To guide the party, a list of the gas consumers arranged by streets was furnished as well as a gas main map. They also had access to some construction report sheets which had been made during the last two years when service pipes were laid. As far as they went, the construction report sheets were a valuable guide, but in almost every case more pipe and fittings were listed on the sheets than could be accounted for on the ground. The reports turned in by this inventory party, however, recorded only such pipe, and fittings as could be accounted for and did not include any shown on the construction sheets which could not be located on the ground. Following the same method, at places where no construction sheets were available the pipe and fittings were listed.

A gas main party listed the gas mains on the sheets previously turned in by the gas service and its meter party. The location of the mains was determined from the data on the gas main map, which had been proved by excavation, from information obtained by the gas service and meter party and from measurements made on the ground. In the newer parts of the town the surveyed distances were used, but in the older parts of town all the gas mains were measured with a tape.

To determine the depth of the gas mains and the service pipes and to obtain data which could be used in estimating the excavation necessary to lay the pipes, excavations were made in about forty places in town, principally at street intersections. The depths were laid out on street profiles in the drawing room and the depths at intermediate points interpolated. The depths thus determined were entered on the report sheets and when the sheets were totalled the average depth was also put down. The final report gives the length of each size with its average depth.

The condition of the pipe was noted during the excavations as well as the character of the ground in which it was laid. From data thus obtained approximate boundary lines were drawn on the map which marked the limits of easy and hard digging, the easy digging being in earth and gravel and the hard digging in a hard cemented material.

No attempt was made to arrive at a percentage covering the condition of the gas pipe, first because the data obtained by digging was meagre and represented only a small portion of the pipe, and second because the condition was so uniformly good that it was felt it would be a waste of time.

There were, at the time of making the inventory, a number of gas and electric meters in the test rooms. These meters were listed and added to the totals of the meters found in service. As it took some time to make the inventory, it was necessary to run a check to see that no meters found in the respective test rooms had been counted in the field. To run this check the office records were consulted and all meters, both gas and electric, which had been set or removed during the time the inventory was in progress was checked up in the notes. All meters set after the inventory party had visited a house and before the test room count was made, were entered in the test room list as being in the test room on the date of the inventory. All meters removed after the inventory party had visited the premises and later found in the test room, were crossed off the test room list and left in the notes as being in service at the date of the inventory. Three electric meters were found to have been counted twice, having been removed from one location, and installed in another, while the inventory was in progress.

While the greatest care was taken to avoid omissions, it is recognized that they will occur. Duplications have been guarded against by checking one party's work by the following party's notes, and by entering the data on a map. Omissions cannot be checked this way and a percentage should properly be allowed to cover omissions.

In the determination of the unit values to be applied to the various parts of the property many authorities were consulted and the company's records used wherever possible. The company had pole prices and was doing considerable work at that time which made it possible to obtain costs of poles delivered, with freight, cartage, shaving painting, cartage to site, erection, in good detail. It was, of course, easy to obtain prices on cross arms, insulators and other items.

For the determination of unit prices for copper wire, the price of copper for the last five years was ascertained from four or five different sources and the results averaged and compared with the figures the company's books showed had been paid for copper wire which it had purchased, from which an average figure was taken representing the cost of copper wire over the period covered by the previous five years. With this figure as a basis and the company's records it was possible to make additions for reels, erection, hauling, losses, etc., and to finally assign a unit price of so much per pound for the erection of each size of wire. This unit price was applied to the quantities contained in the inventory.

Transformers, meters and arc lamps were valued on prices as at present current, but the gas pipe and gas fittings were treated somewhat similar to that of copper wire; that is, prices for some years back were averaged.

The present value of the electric distribution system was found to be 90 per cent of the replacement value new. It may be of interest to note that three engineers, after looking over the property before the inventory was made, set a figure of 90 per cent as the condition of the property and so testified before the commission.

The present value of the gas distribution system was found to be 80 per cent of the replacement value new. This lower figure was caused principally by the low value put on some of the cast iron pipe which had been used for many years.

The present value of the whole property including land, power house and distribution systems was found to be 87 per cent of the replacement value new.

DISCUSSION ON "DESCRIPTION OF AN INVENTORY AND VALUATION OF A GAS AND ELECTRIC PLANT."

Chairman (P. T. Hanscom): Mr. Crozier has given us a very commendable paper. I feel sure, however, that he has some ammunition in reserve, and I hope that in the discussion, which is now in order, the members—or any parties present—will not hesitate to tackle any angle of the subject.

Question: Was there any difference in the operations of the company between maintenance and replacement charges? I understand, in replacing copper wire you would charge it to maintenance; but was there any segregation made in operating expenses between depreciation charge or maintenance charge?

H. W. Crozier: All replacements were carried along as maintenance. Of course depreciation reserves were supposed to be carried; but the reason we worked on this theory in making the inventory was that this thing was actually going on at the time I was there.

J. T. Ryan: The value there of the depreciated condition is not entirely clear to me. Suppose you make a rough calculation. Take No. 2 weather proof wire, assuming it at 18 cents a pound, would make about $46 a thousand feet. The cost of stringing would be somewhere in the neighborhood of $4 a thousand feet; $46 for the wire and $4 for the stringing would bring up the total value of the weather proof wire in position to $50. Suppose the insulation of that wire had almost entirely disappeared and would be classed in the last column, that would give you 77 per cent of its new value.

H. W. Crozier: That is, given a certain amount of copper wire in place, and supposing the insulation badly worn, would it be properly charged, as we have done, by taking the percentage off and leaving only the bare wire. What we really did is to take 80 per cent of the replacement value, which includes the erection. We have taken 80 per cent of the erection too, so we have left in there some of the erection; but you see the erection comes out of the maintenance expense. We have got to put some more erection in to put more wire in its place. It is all taken care of in the maintenance expenses, so any particular wire in place has its erection charge in there. If we take that wire down, and put another wire in its place the erection charge will stay there. It will really go into operating expenses. If you view it that way, all the charges of taking wire down and putting it back go into operating expenses, which as a matter of renewal is correct.

S. J. Lisberger: You said something in the paper about the use of poles, about taking a 40 ft. pole, and after it had been in the ground some years, cutting off the rotten part that had been in the ground and using it as a 35 ft. pole. Do you think your figure of 80 per cent was a fair figure with such a pole?

H. W. Crozier: I think my figure of 80 would be better than 75 that the engineer in charge of valuation decided to allow. I worked that out exactly from the operations by watching the maintenance department. They were taking poles, down, hauling them off and using them again, or, cut the butt off and reset the poles as they stood. Or another scheme they had in some parts of town was to put in a new butt; (stub the poles), and in the case of a 40 ft. pole being replaced new as a 35 ft. pole they would usually only use about three feet of it, so it would really be about 37 ft. In most cases I noticed they would get a 32 ft. pole out of a 35. They were making more changes than I have allowed for, so I think this figure is more than fair.

S. J. Lisberger: It is my experience that poles reset like that have a comparatively short life. Conditions in Arizona may be different from California, owing to climate. I don't recall an old pole having been up say ten or fifteen years being good for fifteen years more after having been reset.

H. W. Crozier: That is perfectly true. In California this arrangement would not work because there would be a lot of deterioration in the top, particularly the crossarm gains. I believe there is not a pole in the whole town that the out of ground portion was not just as good as the day it was put up, except badly split, down the middle. A pole checked right down the middle I look upon as about as good as we could get. You might buy a new one, and in a year it would be that way; so a reset pole checked down the middle was just as good as a new one, assuming it was a year old. The redwood poles were much better than the cedar.

S. J. Liesberger: You spoke of inspecting the paint on the poles. How did you arrive at that? It is rather a novel point—not determining the quality of paint, but to determine the replacement value of a painted pole.

H. W. Crozier: I took the position that I did not care whether a pole was painted or not except for the appearances. I believe in that climate it does not make any particular difference. The condition of the poles in Arizona is peculiar in that they have a single split, which would be about half the diameter in depth, right down the side. You might paint all the rest of it, but I don't think it made any particular difference in the life of the pole. I regarded it entirely as a matter of appearances. We felt that a painted pole really had some protection because it would resist this cracking for a while, but not long. So the men making the inventory really rated the condition of paint by appearances. There is one thing I wanted to say in regard to painting. As far as I could see, it did not make any particular difference whether a pole was painted or not; but every time I checked up the inventory parties they would always give a higher value for a pole when there was some paint on it than they would if it wasn't painted. That is perhaps a psychological thing to keep in mind when the inventory is going to be made, that is get the paint pot busy beforehand.

J. T. Ryan: One of the most confusing things I have encountered in connection with valuation is the matter of omissions. I have always taken the stand that in inventory taken in careful detail, as Mr. Crozier has mentioned this evening, we haven't any real justification for including anything for omissions. Take for instance the Pacific Gas & Electric Company. They have 3,350,000 ft. of gas mains. If we should allow them for omissions and apply that factor it would mean 60 miles of mains. That would probably be too large a factor to use in connection with a plant of that size. I wondered if the author has made an investigation of a plant that justified the conclusions reached, or had taken his general experience.

H. W. Crozier: That is the part we were very much worried about ourselves. When we had all the work done, as I said, in the inventory count here, we found that the next party along there found four more poles. There were four more poles that they did not get—that the original party did not get, although they went over the ground, numbered every pole in town and tried to get every pole there was. Another party had to put down all the arc lamps, and had everyone of the arc lamps down, with the name of the street intersection and the whole business. We knew that we had 105 arc lamps, because we were getting paid for them, and the city had checked them up time and again. Yet this inventory party, working in detail, had missed some; and they had all the street intersections and everything.

They did the same thing on transformers, and missed some transformers absolutely, and yet they had absolutely nothing to do but to list the poles and transformers. I think the omissions on transformers—I don't remember what it was exactly, but I think it would amount to four transformers. Whether it amounted to 2 or 3 per cent of the total I don't know. I know there was one 50 kw. transformer missed.

By the use of all that data we estimated that on these items there is no question there was something like 2 or 3 per cent of omissions. We fixed these amounts of course because they were of some importance and we were able to chase those down, so when we were finally completed with our inventory we were right on them.

A. J. Bowie: When a system grows there will be a number of services and connections which will be practically useless, which, if anyone were replacing the plant, would not be replaced, but which are a natural part of the condition of growth.

H. W. Crozier: That is very true. There were a lot of old and capped services in older districts and in the adobe houses which were not used and perhaps never would be replaced. We put those all in as actual property of the company, and I suppose should have charged off something for obsolescence; but they really amounted to a very small proportion of the property, because in many cases there would be a single gas lead running to a stove, which would branch with a T, which connected two houses. Sometimes one of these would not be used, and the other would, and the small 6 or 10 ft. coming into one of the houses would perhaps be obsolete. There were other cases where the service piping would run to the back of a row of adobe houses, and there might be one of the row taking gas, and service connected to two or three of the others. Some of those little branches were obsolete, and perhaps the large size pipe going in there would be a little more than was necessary, but the total was very small.

A. J. Bowie: I refer more particularly to the mains than to the branch services.

H. W. Crozier: Regarding mains, I think that everybody felt that the gas mains were pretty small, and if anything was to be criticized about the property it was that they ought to have been larger.

W. G. Vincent: The question with regard to omissions is always a hard one to handle. Personally I do not favor making allowance for omissions because it immediately weakens the basis of your inventory. If you think there is a lot of stuff that you have missed it discredits the balance of your inventory.

I do not feel that they run as high in percentage of value as Mr. Crozier has included in his inventory, although it depends upon conditions. If you would go out and make a house to house canvass of all your gas services in the town, and look up the mains that supply all those services, how you can add 10 per cent to your mains for omissions I do not understand.

On the other hand, there is another class of omissions which should be considered, and those are the omissions which cannot be inventoried, that is, the materials necessary in the construction of a job that are not afterwards found on the job. For instance, some years ago I had occasion to check up some transmission line construction, three different jobs of about 55 miles of line; had complete records of the materials issued and charged to the job in detail, and I had inventories made in the field, counting everything in the line. In a transmission line you can see pretty nearly everything that is there. I compared the field inventory material with the actual materials that had been charged and gone to the job, and the actual material that went to the job was a little over 6 per cent in excess of what was actually found on the ground. In taking care of that we made an allowance, in valuing the transmission line, of a certain percentage of material that went into the line, and handled that as excess materials. There are odds and ends of materials taken to the job and not used. May be there is a pole left out somewhere where it does not pay to bring it in. As Mr. Crozier pointed out, they used a lot of fittings that were not necessary. I think omissions of that character should be taken as a lump sum in the unit cost.

The inventory described by Mr. Crozier is made in great detail—in fact in greater detail than most of them are made. I think the tendency is to get away from a great amount of detail, especially on small properties. The expense is burdensome; and it is usually the case—although I think conditions down there were such that they probably could not have done better—that where you have an engineer on each side working on the job, certain general assumptions and estimates can be made to cover the minor items, which will avoid the necessity of counting all of the small pieces of apparatus and equipment that go into the construction. For instance, average lengths for the service can be worked out. In the same way on the electric services and the installation of your meters, cross-arms and hardware. The pole hardware can be worked out to a unit per pole, which will be practically accurate. Some time ago in connection with that I worked up to see if it was worth while to make note of the size of each individual cross-arm in a distribution system, and I found that by taking the detail inventories of six cities, and getting an average value per single cross-arm, it averaged from $1.17 to $1.33, a variation of about 13 per cent for all sizes of arms. Now the cross-arms run about 5 or 6 per cent of the total value of your overhead distribution system; so if you miss your estimate on the value of the arm by 13 per cent it would make a difference of .8 or 1 per cent on the value of the distribution system. That is a pretty small error. So I think the tendency will be to get away from the great detail, and to generalize more and more on those general items.

The question of the poles that Mr. Crozier spoke of is rather an unusual one, and we do not find any such conditions in California.

J. T. Ryan: One of the factors in the paper that has appealed to me more strongly than anything else was the very comfortable factor of time that was apparently permitted. It is the usual experience in matters of valuation that the appraisement is never decided upon except as a last resort—something on the principle of a surgical operation—and is only authorized when the necessity for it has become exceedingly acute. When the question is asked, "How soon is the report desired?" the usual answer in my experience has been "Yesterday"; and I have never had such a comfortable factor of time in a valuation that I have been associated with as the author apparently had. That acts as a greater determent to taking the inventory in detail than any other one thing, because when the appraisal is decided on it is usually accompanied with such urgent need for the final result that it makes it necessary to eliminate all unnecessary detail, and sometimes cuts the factor of time for mature deliberation on points that sometimes we found later it was necessary to go over and do work again.

I have found, though, that it is possible to get accurate field data on quantities of some variety of material without even taking field notes of them. For example, in the matters of insulators and pins on the pole line they can be assumed within a very close limit of accuracy from the number of spans of wire, plus the number of double cross-arms; and very often it is the case that the inventory is burdened with an immense amount of detail that tends to confuse and hide some more important elements of the value. I had in mind the fact that after a very careful computation of the age and physical condition and observed depreciation made in the inventory, it only justified in the end estimates made previously by engineers of the actual conditions of the property.

Of course in making an appraisal that is designed to stand the cross-fire of conflicting interests in a rate case it is necessary to make provisions that will not be necessary for some other cases of appraisal, which would be satisfied with something less elaborate.

THE POSSIBLE FAILURE OF WELL IRRIGATION IN THE SAN JOAQUIN VALLEY.

BY A. L. COLLINS.[1]

The amount of water in the ground available at any time for irrigation is (1) the water stored in the earth and accumulated during the past ages, (2) and the water that flows into the ground each year and is lost by seepage and evaporation. The latter amount is the perpetual water supply, and any demand beyond this will encroach upon the storage supply.

It must be recognized by all that there is a reasonable limit to the amount of water that can profitably be taken from the ground.

If we do not believe that the amount of water is limited, we must forget the better known laws of nature and treat the existence of the ground water as a special act of Providence.

In this article regarding the San Joaquin Valley the questions are asked:

(1) Does the ground contain sufficient water for a perpetual standard irrigation supply?

(2) Is the rainfall sufficient to fill up and maintain the ground water levels, showing that the sand strata are fully replenished each year?

(3) Can the rivers, only in very exceptional cases, be depended upon to replenish the exhausted water sands?

(4) Can the rainfall and resulting seepage from the mountains be depended upon to replenish the valley sands and gravels?

(5) Is the common type of irrigation well and plant now considered permanent, but temporary?

The negative side of these questions is discussed here, hoping that criticism will be made by people best qualified to answer, and who are almost certain to take the affirmative.

The failure of the underground water supply means the lowering of the water in the well until the cost of pumping absorbs the profits of the crops. Such a failure does not necessarily mean that the land that has been developed will become a barren desert, but it does mean that the community will be disappointed and that only the more fortunate will be contented.

To get the proper conception of the existence of the ground water supply, in the San Joaquin Valley, we must forget the impressions of our childhood days, such as the wonders of the mammoth caves and the spouting geysers, and use the every-day examples of nature as a basis for our reasoning, rather than the exceptions and freaks.

To the uninitiated, a moist earth plot a few feet square, with a green covering of grass, is accepted as an indication of "an inexhaustible water supply."

In the interior valleys of California, it must be recognized that water is a necessity for profitable crops, and for the success of the valley.

The experiments carried on by the agricultural experimenters, and the experience of the water companies, would indicate that there is almost a standard amount of water required by each crop. Of course, the results are varied, depending upon the type of soil and other conditions.

It is the consensus of opinion that alfalfa should have from 1½ ft. to 3 ft. depth of water applied by man during the season. Now there are patches of alfalfa on the richer sediment soils that will yield from 3 to 5 tons without irrigation, but with the aid of irrigation, will increase the yield to 10 tons.

With few exceptions, the fruit must also have water. This is not saying that the trees will not produce something with proper care, but a farmer is going to be seriously handicapped in making even a living if he insists on dry farming.

There should be applied from 1 ft. to 1½ ft. of water for ordinary fruits.

It should be noted here that while the experiments show that amounts varying from 1½ to 3 ft. deep are applied in certain districts for crops, it is not unusual to apply even 10 feet.

In considering an irrigation system that will use ground waters exclusively, there are two facts which everybody should know, namely: The water supply must originate from the rains, and that the water when in the ground can be pumped only from the clean porous sands or gravel as from a lake. A moist clay or heavy soil contains moisture, but the process of seepage passing to the sands from the clays is a very slow process and is uncertain.

Water for irrigation, if taken from wells, must be supplied originally from (1) the local rainfall percolating through the upper strata; (2) the water percolating into the sands from the rivers, or (3) the water percolating from the mountains by underground channels.

To assist in discussing the statement that the rainfall is insufficient to provide continuous irrigation, the complete rainfall records for the past forty or fifty years of the valley are available, as published by the United States Weather Bureau. By taking the rainfall records of the whole San Joaquin Valley, which includes an area of 250 miles by 50 miles, and using the stations that are not over 500 feet above sea level, the average rainfall is less than 13 inches and the maximum of any one station for any one year is less than 20 inches.

Distribution of the Rain.

There are four sources of distribution for the precipitation, namely: the evaporation, that consumed by plants, the seepage, and run-off.

The evaporation from a water surface, as in a lake, in the San Joaquin Valley, is found to be about 4½ feet for the season. The following table will give an idea of distribution of the evaporation, and the rainfall:

Month.	Inches of Evaporation. (If available.)	Inches of Rain.
September	2.1	0.2
October	1.2	0.7
November	1.0	1.5
December	2.2	2.1
January	2.6	1.8
February	3.0	1.8
March	5.0	1.8
April	7.5	1.8
May	9.2	0.6
June	9.5	0.3
July	7.0	...
August	3.7	...
	54.0	12.6

[1]Consulting Engineer on Power and Irrigation, 112 Market Street, San Francisco.

Experience shows that at least 5 inches of rainfall must fall in a comparatively short time before the soils will permit the water to flow into the drains. This water coming after the intensely hot summers, during which time the ground is thoroughly dried out for several feet down, will be held in suspension and gradually distributed to varying depths. It is known fact that capillary attraction causes the moisture to move towards the surface, which is contrary to the generally accepted theory of fast percolating waters.

In view of the small amount of rain and the large evaporation, and the fact that a well-distributed 13 inches of rain only soaks up the ground for a few feet, should make it evident that the seepage from rainfall in large amounts is uncertain.

It is known that the porous or sandy soils are capable of absorbing large amounts of water, but even then the experience with water standing in ponds and canals with the best soil conditions for seepage and where water is in contact with the banks, should indicate to everybody who has had experience the slowness with which water is absorbed by the soils.

It has been found that in certain parts of the Sacramento Valley there are conditions similar to the San Joaquin, with the exception that there is more rain. About October the ground waters gradually rise as much as 6 inches. The theory by some people is that the winter rains have just reached the permanent ground water strata.

This rise occurs at the end of the dry season and at a time when evaporation is decreasing rapidly. At the same time, the streams rise a few inches, from their head waters to the tides. This would indicate that the rise might be due to either the past winter floods or the decrease in evaporation, or both.

This 6 inch rise means, if we assume the porosity of the soils to be 25 per cent, that a sheet of water only 1½ inches deep has appeared in the lower soils. If the water comes from soils of only 10 per cent porosity, the sheet of water is only 0.6 of an inch in depth.

It would appear that the ground water is fed from below and that the increase in the upward velocity is due to capillary attraction and the rapid evaporation and drying out of the ground during the summer months, and that this under seepage, by its slow movement, is unable to keep up until this season of the year.

The movement of the water can only be the equalizing of the waters distributed at some previous periods of long or short duration.

It should be apparent that this 6 inch raise is only the fluctuation of a sheet of water (even if it is distributed uniformally over the valley) of about one inch, as it would be applied for irrigation.

Assuming that we should have an irrigation of 18 inches in depth to apply on the soil, we have no chance, under these conditions of obtaining the water from the rainfall, to store below the soil.

Seepage from the Rivers.

The time has not arrived in the San Joaquin Valley when it can be stated that rivers furnish the water to the surrounding lands by percolation. The ground water levels nearly everywhere are far above the water in the streams. Now, before the streams can feed an exhausted locality, the water in the well must be lowered to cause the water to flow in a downhill direction, from the stream to the pumping plant. We are further confronted with the uncertain amount of seepage coming from the river, even under the most favorable downgrade conditions. Rivers carrying silt have a tendency to seal up the porous sands. If we will imagine a large sand channel and assume that the sand is of such size as to be favorable for the transmtssion of the largest amount of water with the least fall, nearly everybody will change their conception of the amount of water that sands can transmit.

The United States Government in the last fifteen years has made extensive experiments regarding the velocity of underground water, and reference is made to Bulletin No. 43, by C. S. Slichter. Nearly all the experiments were made in the bed of old streams of uniform sand strata and a similar attempt in the San Joaquin Valley would be impractical, since the strata is very uneven and has very little fall. However, to obtain an idea as to the amount of water that could be transmitted in a sand strata, reference is made to the bulletin. The sands in the valley are nearly all fine, and if we select a sand for an example, as would occur only in the most favored districts, in the San Joaquin Valley, we could not expect the water to attain a velocity of over 10 feet per day, with a fall away from the rtver of 15 feet per mile. Now, assuming that there is a sand bank adjoining a river and that the fall is 15 feet to the mile away from the river, it will take the water almost two years to sweep back one mile and a half. The amount of water then flowing from the river into a layer of sand 10 feet thick, and one mile long, adjoining the river, and assuming that the air space in the sand is 33 1/3 per cent water area, and that the grade is 15 feet per mile, will supply just about enough water for the continuous operation of a 6 inch pump giving 900 gallons per minute.

This sized installation is very common throughout the valley and is more common than exceptional.

It is readily seen that if the banks open into suitable sand strata and that the water in the wells are lowered below the river, there will be a comparatively small flow in that direction. However, one would naturally expect that the sand strata would rise in grade from the river, which would make the reverse of the grade that is necessary.

Practically speaking, the pumping plants as now constructed a few miles back from the river must depend upon the upper foothill flow of the sands until the water recedes in the well a considerable depth, and then it will be neecssary to decrease the capacity of the pump so as to just consume the water that will pass through the sands, otherwise the pump will have to operate intermittantly.

Mountain Seepage Supply.

In considering the mountain seepage supply, it is hard to imagine underground water channels, reaching to the San Joaquin Valley, except through the river passes. We must imagine the water seeping through the rocks, passing under canyons of comparatively low elevations (acting as drains) to appear in the basins of the valley.

Wells that are made adjacent to the foothills more frequently strike clay beds several hundred feet thick, and one would reasonably expect that the clay beds are the tops of hills. One is justified only in saying

that the water that reaches the valleys seeps through the same passes that the surface water uses.

If nature is so generous with water channels extending so many miles under the mountains, it only seems probable that there should be evidences of seepage along the foothills where man could see it.

Does mining operations give evidence that such passages exist as to feed the water into the valleys in large enough quantities to furnish the demands?

Between the valley proper and the mountains there are miles of foothills. Like the mountains, they are steep and any excess of water runs off. The soils are heavy and impervious to water. Only a small percentage of the sub-strata is capable of storing water. Can we depend only upon perhaps small crevices between the two adjacent slopes to store water and furnish the required amounts? The conditions here are not like sections of the United States countries, as in the Middle West, where the same geological formations exist uniformally for hundreds of miles and for a great many miles form immense reservoirs.

We should conclude the waters would have to follow a very non-uniform course and we would have to trust to the thoughtfulness of nature to make the conditions possible.

The Chief Source of Supply for the Ground Waters.

The source of supply upon which the ground water must depend for replenishment reaches the valley from the mountain streams, and at a time after they pass the canyon opening directly into the valley.

The United States Water Supply Paper 220 on the ground waters of the San Joaquin Valley describes the mountain streams as entering the valley through canyons and spreading out in smaller streams taking fan-like directions. The ground water elevation adjacent to these fans have an elevation above the surrounding lands, which is an indication that these streams are the sources of supply. In past years the water has been distributed over these fans and has distributed the present water supply.

With the activities of irrigation during the last fifty years, the summer flows of all these streams are practically all diverted and the water is taken from the main channel and put upon the lands to be wholly used up by the crops. The supply of water for seepage is then limited to the periods of the floods of a few months duration. The amount of water that will percolate into the ground cannot be proportional to the intensity of the flood nor the annual run-off in inches.

The time is not far distant when reservoirs in the mountains will retain most of the flood waters and then even this opportunity for the ground water replenishment will be at an end.

Since the activities of man the source of the ground water supply has been half closed and it is only a question of time until the supply of water accumulated in past seasons and now so abundant will decrease.

Pumping Plants Are Only Temporarily Constructed.

In considering the statement that the common pumping plants are of temporary nature, it is of importance to consider the types and classes of wells and the conditions encountered.

Wells as deep as 2000 feet in the valley basin show the existence of a basin filled in by the adjacent slides and washes from the mountains. The heavy soils, and the sand strata, are generally saturated and the water will stand only a few feet from the surface of the ground. However, it is evident that a great many of the sand strata are only pockets and that they are either dry or the water is dormant, as in a lake.

In putting down two wells 10 feet apart, there is no assurance that the "logs" will be the same. In most cases, however, this same strata is encountered, but it will vary from mere traces to any amount. On the other hand, in placing two wells even a quarter of a mile apart, one well is very likely to lower the water in the other.

It is quite common, again, to put two wells close together, one, say, 100 feet deep, and the other 200 feet deep, one well pumping from the shallow strata and the other from the lower, both independent of each other.

Now, the amount of idle water, if we may term it such, in the sub-soil, can be estimated in a general way. A man putting down a well 200 feet should be satisfied if he can find 20 feet of water bearing clean sands. Assuming that the water space between the sand particles is 33 1/3 per cent, we have a total depth of 6 1/3 feet of clear water.

In order to get out this 6 1/3 feet of water, it will be necessary to exhaust the water from the sands for the total depth of the well, if there is not a general circulation of the water from the surrounding country. Of course, the heavy clays will contain water, but it cannot be expected that they will give up their water only as a slow seepage process.

We have then the two classes of "stove pipe" wells, the shallow wells, about 250 feet deep, and the deep wells, some of them reaching to a 2000-foot depth.

The question is asked, where does the artesian water supply come from? In drilling a 1000-foot well, several artesian flows may be encountered. To have an artesian supply there must be confining layers of clay, hard pan or rock, between which the water is confined under pressure. In drilling a well it frequently happens that each time an artesian strata is encountered, when there are several in the well, the water will rise a certain height, showing that it is under a pressure, and the deeper you go the higher the water rises. This pressure is either due to the water coming from a higher level, several miles away, or from some unknown cause.

It is nearly always asumed without further questioning, that the artesian water is furnished by a stream feeding into the valley at an altitude higher than the outlet of the artesian well and that the supply at the well is inexhaustible.

It is the history of nearly every artesian belt to decrease the flow in time. An artesian well of 50 miners inches continuous flow is a fair well. This well flowing for one year will discharge enough water to cover 8 city blocks (250 feet by 350 feet, containtng two acres) with water to a depth of 46 feet. Assuming that the water must come from sand of which 33 1/3 per cent is water space only, the amount of sand drained

will make a pile that will cover 24 city blocks 46 feet deep.

We have no assurance that the pressure of the water is not the result of the pressure of the loose materials in the valleys, having pushed the impervious clay beds down at some previous period, as could be done by earthquakes, and thus forcing the water back to a higher level, causing a hydraulic pressure, since water is incompressible. We may consider, if we so choose, that the pressure is caused by the slowly accumulated water, at the higher level and that the supply now at hand is not perpetual and in view of the decreasing flaws is not being fully replenished, although there may be a scientific explanation for the lowering of the water in a well without admitting that the supply is diminishing.

In certain sections there is often gas with the water, showing that there has been some kind of a subterranean chemical action which puts the water under pressure.

This discussion of an artesian well brings out the importance of conserving the supply and if we cannot be convinced that the supply is limited, we should at least be skeptical.

Should we but consider these ground waters but dormant, and having been accumulated slowly during the ages? In the artesian wells, we should be surprised only that they are so permanent. Since nearly every artesian well district has apparently a gradually decreasing flow, it is just as reasonable to assume that the well is draining an extensive sand bed of dormant water under pressure, and that it is not continuously replenished nor inexhaustible.

There is a condition that exists in the valley regarding the very short time that is sometimes required for one well to influence another. In view of the impossibility of water attaining any great velocity in the finer sands there must be some unusual conditions in connection with these ground water supplies.

The log of a well will show various strata of hard clay, packed and almost cemented sand, then the loose beach sands, and the sands so finely divided termed quick sands. It is sometimes maintained that the quick sands which is so finely divided and which is so easily suspended in water, may open up a small water space, with the compact clay acting as a roof. The water space may have a fraction of an inch or more of free space a few feet across but in that way provide a rapid means for equalizing the ground waters.

There is however a scientific reason for the sympathetic and rapid fluctuation of the water in a well. The discussion involves the discourse on the equalizing of pressures of an incompressible fluid in a large receptacle with small openings. It is sufficient to say that wells, both artesian and shallow wells, may, in special cases, lower several feet and at the same time the lowering is not the result of an insufficient water supply in the ground but is the equalizing of pressures. This condition is frequently brought about by the activity of a neighboring supply tapping the same basin.

The following statement is an illustration of the large amount of water that is ordinarily pumped with a 6 inch centrifugal pump, giving 900 gallons per minute. It is assumed that the water bearing strata contains 33 1/3 per cent water. The pump operating for 6 continuous months (the irrigation season) will drain a sand pile 46 ft. high, covering 24 city blocks 250 ft. x 350 ft. each, (an area of 2 acres).

Carrying the example farther and assuming that there is only 20 ft. of sand in a depth of 100 ft. of earth this pump will drain a volume of ground that would cover 120 city blocks (250 ft. x 350 ft. each) 46 ft. high, in furnishing water enough for the irrigation of 240 acres of alfalfa, using a 36 in. depth of water.

As stated previously this size of pump is common. The continuous yearly irrigation will no doubt cause a quantity of the water to percolate back in the ground to be used again. But when it is considered that the dependable good water strata is generally down 75 ft. or more, it should be recognized that the sudden starting of irrigation will very likely deplete the lower strata before the surface water can saturate the upper soils and feed to the lower. With the intensely hot summers, and the large evaporation amounting to some times ¼ of an in. a day at a time when the water is applied and the retention of the water by the upper soil it is not reasonable to expect that only an appreciable amount of moisture will percolate to the live sand beds, from the surface irrigation.

The districts where such depths at 6 ft. or more of water is applied in a season (which indicates that the soil is of sandy type) the ground waters stand a chance of being replenished since we are feeding water into the same type of strata as from which we are depending upon our grand water supply. This condition would only exist however where there is a supply of water taken from the rivers and not the ground.

The success of a well depends upon the luck of not only the finding of the water sand, but the selection of a well driller who can make a satisfactory well and in addition the inactivities of the neighbor's plant.

Now if the contentions of this article are correct, and they are based upon the experience throughout the valley, then the common type of pumping plant will have to be replaced by practically a new plant in order to pump under the conditions of the changing water levels. The cost for pumping will increase and the amount of water will decrease as the water levels lower.

The development of a country must depend upon the speculative instinct of the people. Their agents, the real-estate people, the power companies, and boosters are in nearly every case sincere as far as their intentions and information goes, but it may be discovered at a later date that their first efforts were based upon ignorance and a misconception of the ordinary physical laws of nature, and that they had placed their hopes too high.

It is not the intention in this article to claim that the successful well installations are an exception to the rule, nor that the water will be entirely exhausted, nor to discredit the fact that the individual well installations at the present time are a paying investment. The water in any amount, will add to the value of the land, but the public should be informed as to what they should expect in the future and if there is a limited water supply, to make it known that the amount

is limited and that an effort should always be made to put in the most economical plant and to assist in developing storage reservoirs for conserving the flood waters, in the mountains for the continuance of their best interests.

The outcome of the colonization schemes will be first an increase of acreage as today and continuing for an indefinite time, then followed by the water in the wells falling rapidly which fact will probably be attributed to dry years. There will then be the survival of the fittest and the monopolist will use a minimum of water and sell the rest to his unfortunate neighbor. The company or individual today who has foresight enough to see that his well development is based on conservative lines, can control the water supply of the community.

ELECTRIC PLANTS IN ARGENTINA.

Electric light will shortly be installed in the suburb of Caseros.

In May next work will be commenced on the electric light station estacion Cruz, Cordoba.

J. G. White & Company, concessionaries for electric tramways in the city of Santa Fe, have passed same over to the Argentine Tramway & Electric Power Company, they remaining as guarantors that the work will be carried out. Material is arriving, and the work will shortly be pushed.

The Hydroelectric Company of Tucuman has offered to the municipality of that city to undertake the entire illumination at a reduction of 12 per cent on the actual amount now paid to the Cia. Electrica del Norte. It would mean a reduction in the public lighting bill of $500 monthly.

Work has been commenced on the building for the electric power house at General Pico (Pampa).

A GENERAL SUMMARY OF IRRIGATION IN THE UNITED STATES.

The table which follows summarizes the principal data for the arid region as a whole as returned at the census of 1910; unless otherwise indicated the figures relate to the year in which the census was taken. The general agricultural statistics given for purposes of comparison cover the entire areas of the states included in the "arid region," although in some of the states the territory which requires no irrigation vastly exceeds the irrigated lands. The number of farms irrigated is the number of farms on which irrigation is practiced, regardless of the extent of such irrigation. The acreage irrigated in 1909 is that reported by the special agents from information secured from owners or officials of irrigation enterprises or, in some instances, from public records. This acreage is probably in some measure an overstatement; it is believed, however, that the acreage given is within 10 per cent of the correct figure. In addition to information as to the acreage irrigated in 1909 data were collected as to the acreage the enterprises were capable of supplying with water in 1910 and the total acreage which enterprises completed or under way in 1910 were designed to supply ultimately (designated as "acreage included in projects").

Class of enterprise.	Acreage irrigated in 1909.	Acreage enterprises were capable of irrigating in 1910.	Acreage included in projects.	Average cost of irrigation enterprises per acre. Based on cost to July 1, 1910, and acreage capable of irrigation in 1910.	Based on cost to July 1, 1910, and acreage irrigated in 1909.	Based on estimated final cost and acreage included in projects.
U. S. Reclamation Service..	395,646	786,190	1,973,016	$67.52	$134.17	$48.14
U. S. Indian Service.....	172,912	376,576	879,068	12.78	27.83	13.33
Carey Act enterprises	288,553	1,089,677	2,573,874	30.53	115.30	21.75
Irrigation districts	528,642	800,451	1,581,465	27.37	41.44	20.33
Cooperative enterprises.....	4,643,539	6,191,577	8,830,197	12.89	17.19	10.07
Individual and partnership enterprises	6,257,387	7,666,110	10,153,545	7.09	8.69	5.22
Commercial enterprises ...	1,451,806	2,424,116	5,119,977	24.98	41.71	16.79
Total	13,738,485	19,334,697	31,111,142	.....	.....	.....

	Census of 1910
Number of farms[1]	1,440,822
Approximate land area[1]—acres	1,161,385,600
Land in farms[1]—acres	388,606,991
Improved land in farms[1]—acres	173,433,957
Number of farms irrigated[2]	158,713
Acreage irrigated[2]	13,738,485
Acreage enterprises were capable of irrigating	19,334,697
Acreage included in projects	31,111,142
Number of enterprises	54,700
Total length of ditches—miles	125,591
Length of main ditches—miles	87,529
Length of lateral ditches—miles	38,062
Number of flowing wells	5,070
Number of reservoirs	6,812
Capacity of reservoirs—acre-ft	12,581,129
Number of pumped wells	14,558
Number of pumping plants	13,906
Capacity of power plants—horsepower	243,435
Acreage irrigated with pumped water[2]	477,625
Acreage irrigated from flowing wells[2]	144,400
Cost of irrigation enterprises	$307,866,369
Average cost per acre[3]	$15.92
Average cost of operation and maintenance, per acre[2]	$1.07

[1] Figures relate to entire areas of states in the arid region.

[2] In 1909.

[3] Based on cost to July 1, 1910, and acreage enterprises were capable of irrigating in 1910.

The total acreage irrigated in 1909 may be thus classified by sources of the water supply: From streams—by gravity, 12,763,979 acres, by pumping 157,775 acres; from wells—flowing 144,400 acres, by pumping 307,496 acres; from reservoirs, 98,193 acres; from lakes—by gravity 58,284 acres, by pumping 12,354 acres; from springs, 196,186 acres; total acreage irrigated, 13,738,485; total acreage irrigated with pumped water, 477,625. More than nine-tenths (92.9 per cent) of the acreage irrigated in 1909 was supplied with water by gravity diversion from streams, and, including cases where water was pumped, streams constituted the source of supply for 94.1 per cent of the total acreage irrigated. Wells supplied the next largest acreage, 3.3 per cent of the total, about one-third of this acreage being watered by flowing wells. Springs furnished the supply for 1.4 per cent of the total acreage irrigated, and reservoirs and lakes each for less than 1 per cent. Of the total acreage irrigated from wells, California contained 77.6 per cent and New Mexico 12.1 per cent. In the case of the other sources of supply the acreage irrigated was more generally distributed among the states.

Size and Cost of Various Enterprises.

The magnitude of the various irrigation enterprises, by general classes, appears below, the schedule also showing the average cost per acre:

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Self-Adjusting Rate Fixing

Wildcat ventures are too recent in their exit in the West to need any detail words of warning looking toward avoiding their possible reappearance in our commercial and financial activities. The adventurous life and habits of the "forty-niner" unquestionably had their effect upon the succeeding generation in creating, for many years, a gambling spirit which largely pervaded many of our Western enterprises. The wholesale manner in which stocks were issued for mining, irrigation, power and agricultural projects often running in the millions with no—or scarcely any—tangible assets forcefully bear witness to this fact.

In this second day of serious reflection, the question of giving any money or par value to stocks is often raised. For instance, many urge simply enumerating the total number of shares comprising the corporation without assigning any value to it save its current market price.

It would seem, however, since regulation of public utilities has definitely established the fact that any utility is entitled to a reasonable return on the actual money invested, that the best method of treatment in the final analysis would be to allow such corporations to issue stock to actually represent the capital invested.

In our numbers of November 28, 1912, December 7, 1912, and the two most recent issues, F. K. Blue has set forth a remarkable scheme for a self-adjusting standard for rate-fixing. Under this proposed method the price of the product of a utility is based on the market price of stock during the preceding year. At first glance this seems wholly unjustifiable in that abnormal stock valuations would at once ensue, yet, by carefully following Mr. Blue's arguments, it is seen that what actually will happen is that the stock will automatically lower in price to its proper level or else the purchaser must accept a lower return on his money.

The practical application of such a scheme offers simplicity in every detail. The rates are automatically adjusted by taking into account the amount of money actually invested, the quantity of the product sold, the cost of operation and the average market price of the stock—all matters of positive record.

Under the present systems of commission regulation, a misrepresentation or an error may bring about undue returns to a utility or, on the other hand, a loss may actually be sustained without remedy. Under the proposed scheme, however, surpluses and deficiencies, year by year, are amortized out over a series of years and perfect automatic readjustment thus follows.

It is of course to be seen that such a proposal virtually guarantees a reasonable return on utility investment. But since the tendency of the times is to prevent any greater returns than a reasonable rate of interest, such a guarantee on the part of the consuming public is only just and reasonable.

The detailed illustration on this subject concluded in this issue is worthy of careful consideration by all rate-fixing bodies.

The Possible Failure of Well Irrigation

The transition period from the old West to the new has been brief but effective. Many are prone to question whether even the great works of the Almighty may not be materially affected by the Herculean tasks of the age. The construction of giant sky-scrapers, the demolishing of huge mountains, the changing of the ocean currents, and the creation of vast eddies in the atmosphere due to untold heat units emitted from the industries must surely have some tendency to unbalance the natural creation of the great architect.

The contemplation of such thoughts as these has lead many noted scientists to compute the period at which the supply of certain natural resources may be reasonably expected to play out. First came the cry of the timber conservationist, then the coal-ceasing-period computer and lastly that of him who fears a ceasing of our underground waters.

Like the early days of gravity systems of irrigation in the West, well-pumping may, if not safely and scientifically directed, end in many heart-breaking disasters. While data to extreme refinement have never been gathered regarding the underground waters of the West, still enough is of record to show the remarkable results that may be obtained. In Southern California about 200 second feet of underground waters had been developed up to 1907 and this volume irrigated about 125,000 acres. While the duty of water in the San Joaquin valley and other productive sections of the West, due to varying crops there prevailing can never probably be as high as in Southern California, nevertheless on the same basis of computation wonderful potential possibilities may be shown. As pointed out by B. A. Etcheverry before the Commonwealth Club of San Francisco, authorities of the United States Geological Survey place the present volume of ground waters used in the San Joaquin valley at 300 second feet and estimate a total available supply of 3000 second feet. This would then be sufficient to irrigate 1,900,000 acres of land. The present area under irrigation in the San Joaquin valley is 2,150,000 acres, and the total estimated arable area is 7,500,000 acres.

The total mean annual flow of the main streams of this valley totals 12,122,400 acre feet and if entirely bottled up and consumed for scientific application would cover the entire arable area to a depth of 20 inches. The gorges and canyons of the Sierras teem with possible reservoir sites. Hence in the ultimate development of this fertile valley by storage and pumping the former will materially aid the latter, for 30 per cent of these stored waters will again find a reservoir haven for man's use in the great underground channels of the earth. So useful and pliable has this underground storage been found that the waters of the Santa Ana River in Southern California during the flood period are annually disgorged over an enormous area and again pumped to surface for irrigation during the proper season.

Many instances are of record in the West where the underground water table is actually raising each year. Indeed careful governmental experiments show that at least 30 per cent of the water used in irrigation returns again to replenish this supply. The data quoted from the Sacramento valley in the article referred to in which it is attempted to show that the water table is replenished annually only six inches in depth is far from complete. Who can say but that a slight lowering of this water level by pumping may not possibly divert countless other underground streams to this diminishing area? Again, did not engineers for twenty-five years compute to a nicety the time when the great Salt Lake would grow dry, for it was observed to lessen in height by a constant amount each year? To look at the waters of this lake this year which are even now almost splashing over the rails of the Lucin cut-off, is to warn the engineer to be conservative and forget not the cycles of repetition that may be at work, yet unknown at present.

The veritable thousands of obstacles that have been overcome in the West, many of which were accomplished in the face of precedent and hitherto established reasoning, make us all bare our heads in solemn reverence for the unfailing provision that has been made for our Western needs and happily to chant the old proverb of Confucious:

"The stork has long legs,
The duck has short legs,
The stork cannot make his legs short,
The duck cannot make his legs long.
Why worry?"

The Saving of Water

Our readers are familiar with the Utah plant that pumps a portion of its power-developing waters in order to drop a neighboring stream through the water wheels and thereby utilize a portion of the energy which would otherwise go to waste. Our leading article of this issue presents another interesting phase of the methods made use of in the West in the recovery of power which would otherwise go to waste. The municipal water system of Seattle has an intermediate service reservoir, the overflow from which ts 412 ft. above Lake Union. As there is available approximately 60 second-feet of water from this source, the power recovered which would otherwise be wasted foots the neat total of 1500 kw. at the switchboard.

This installation at Seattle is not only interesting in its actual physical make-up but especially so when considered as one of the many possibilities that may be taken advantage of in municipal and community growth for the development of power. It is true that often such sources of water supply must be intermittent in character. Such powers, due to the headworks and other constructive features being already available, may as a rule be developed at a remarkably low figure per horsepower installed and if run in conjunction with a steam auxiliary as is contemplated at Seattle maximum continuity of service is easily attainable.

The lesson is a forceful one, then, and Western engineers should be alert in ferreting out other possibilities of this nature. Thus is true conservation most easily acquired.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Samuel Hill of Maryhill, Wash., good road advocate and telephone official, is at San Francisco.

Wynn Meredith, of Sanderson & Porter, has returned to his San Francisco offices from Vancouver, B. C.

F. H. Leggatt, Pacific Coast district manager for the Western Electric Company, is at Hot Springs, Va.

E. K. Wilde, superintendent of the Australian Gas Company, at Sydney, Australia, is visiting California.

H. B. Squires, manufacturers' representative, with headquarters at San Francisco, is in Southern California.

C. H. Johnson, pole specialist with the Western Electric Company, has returned to San Francisco from the Northwest.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, has returned to his San Francisco offices from Los Angeles.

A. M. Dickinson, representing Hubbard & Co. lines with the Pacific States Electric Company, has resigned to enter into business for himself.

Joseph Jacobs, consulting engineer at Seattle, delivered an address on "Engineering as a Profession" at the University of Washington, April 23rd.

E. L. Barnes, district manager for the American District Steam Company, has opened new Pacific Coast offices in the Hoge Building Seattle, Wash.

J. D. Ross, superintendent of the Seattle municipal plant, delivered a lecture at Seattle on April 29, on "The Best Lighting Plant in the World."

A. V. Olson, formerly with the Fobes Supply Company at Seattle, is now with Pass & Seymour's Pacific Coast office with headquarters at San Francisco.

Henry T. Scott, chairman of the executive board of the Pacific Telegraph and Telephone Company, has returned to San Francisco from a three weeks' visit to New York and other points.

J. B. Stannard, consulting engineer, has returned to his office in the Henry Building, Portland, after conferring with the municipal authorities at Baker City, Oregon, regarding plans for a lighting plant.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, has removed his San Francisco offices from 88 First street, to the Aronson Building, on Third street, near Market.

J. J. Gorman has been elected president of the Manhattan Electrical Supply Company to fill the vacancy caused by the death of **H. T. Johnson**. **B. H. Ellis**, treasurer of the company, was also elected vice-president.

Frank E. Watts, reigning Jupiter of the Jovian Order, has resigned as manager of the Sunbeam lamp department of the Western Electric Company to join the advertising staff of the Electrical World of New York City.

D. W. Standrod, jurist and capitalist at Pocatello; **John A. Blomquist**, Boise, and **Alex. P. Ramstedt**, banker, at Moscow, have been appointed members of the newly created Idaho Public Utilities Commission, which will be organized on May 7.

L. B. Wickersham has been promoted to the office of chief electrical engineer for the Oregon Electric & United Railways at Portland, Oregon, having been succeeded as chief engineer of these roads by **A. M. Lupfer**, who recently succeeded **Ralph Budd** as chief engineer for the North Bank and affiliated railroads.

MEETING NOTICES.

Portland Electric Club.

The next meeting of the Electric Club of the Portland Railway, Light & Power Company will be held in the company's hall at First and Alder streets, Monday evening, April 29th. The speaker of the evening will be Mr. Harrison Allen, on "Commission Charts."

Electrical Development and Jovian League.

Last Tuesday was Pacific Gas and Electric day at the weekly luncheon. No business was transacted and the members present enjoyed a most instructive little talk by Mr. Fred Myrtle, advertising manager of the company, on the progress of the Spaulding Dam construction work. The address was supplemented by a fine collection of colored views.

Alameda County Electrical Development League.

The regular monthly meeting of the Alameda County Electrical Development League was held at the Hotel Oakland, Oakland, on Saturday, April 26th. J. A. Vandegrift presided, there being an attendance of about thirty members. The principal subject for discussion was "The Advantages of Membership in the National Electrical Contractors' Association." The next meeting will be held on May 21st, when the lamp question will be discussed.

Portland Electrical Contractors' Association.

The Portland Electrical Contractors' Association met Wednesday evening, April 23, at the Portland Commercial Club, at 6:30 dinner.

The nominating committee offered the following names for officers for the ensuing year: W. O. Fouch, president; Robt. Skeene, vice-president; F. C. Greene, secretary; J. R. Tomilson, treasurer; E. L. Knight, J. Drouillat, R. T. Littler, S. C. Jaeger, executive committee.

The new Universal Price Book for Oregon has now been gotten ready for the printer.

It was suggested that the semi-annual convention of the State Association be held in June during the Rose Carnival and a committee is now working on arrangements for same.

Oregon Technical Club.

Mr. J. E. Davidson, vice-president and general manager of the Pacific Power & Light Company, acted as chairman at the regular Tuesday luncheon at the Portland Commercial Club. He also was the speaker of the day, due to the fact that Mr. Guy W. Talbot, president of the Pacific Power & Light Co., was called out of the city and could not keep his appointment to speak to the club.

It was announced that the Architectural Club of Portland would hold an exhibition of all the plans and pictures of the buildings constructed along the coast during the last three years.

Mr. Davidson's talk was in opposition to the Celilo Power Development by the States of Oregon and Washington. The points he brought out were as follows:

1. No present market.
2. The tax on the people to pay for the development.
3. Low rates now existing in the cities in which power would have to be sold.
4. At present his company has a transmission system in the upper Columbia district costing $400,000 from which the gross revenue was only $20,000 per annum.
5. Competition of government irrigation projects in central Oregon.
6. The high elevation of the irrigation district between the Columbia River and the Yakima River prohibits electric pumping.
7. The moral obligation the people owe eastern bonding companies in not causing them losses on their investments which were placed here in good faith and from which they should realize from after going through the hard pioneering development work.

Mr. Corbin of the Engineering Club of Seattle, addressed the members and extended to them a standing invitation to attend the Seattle Club's luncheons which are held Thursday noon at the College Club, whenever any member of the club might happen to be in Seattle. The club adjourned and went in a body to visit the Portland Trades School.

The noon day meetings beginning with the month of May will be held on Monday (instead of Tuesday) at the Portland Commercial Club dining room "B." Time 12:15 sharp.

Monday, May 5th—Speaker, Prof. F. L. Griffin of Reed College. Chairman, Jas. R. Thompson of Oregon Society of Engineers.

Monday, May 12th—Speaker, Dr. Calvin S. White. Chairman, Robt. G. Dieck.

Monday, May 19th—Speaker, Jas B. Kerr. Chairman, H. W. Whitney.

Monday, May 26th—Speaker, Prof. E. H. McCallister of the University of Oregon. Chairman, H. S. Wells.

Los Angeles Section, A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers held its regular monthly meeting at Hotel Hollenbeck, on Tuesday evening, April 22, 1913. George A. Damon was in the chair, 74 being present. Mr. Lee Hagood of San Francisco, engineer for the Oro Electric Corporation, delivered an illustrated lecture on transmission lines and synchronous condensers. In his talk, Mr. Hagood applied convenient, original, graphic methods of working out data for the selection of condensers to be used as voltage regulators and for the control of power factor in such a way as to be of great interest to all. The paper was discussed by H. A. Barre with reference to use of synchronous condensers on the Big Creek project of the Pacific Light and Power Corporation, now under way. Others participating in the discussion were Budd Frankenfeld, George H. Stockbridge, Ralph Bennett and R. W. Sorensen.

Society for Electrical Development, Inc.

The contest announced by The Society for Electrical Development to secure a suitable trade-mark to be used by its members and by the society in its various campaigns to develop the uses of electricity, has been productive of almost an embarrassment of riches, and the accumulated ideas and suggestions that await the meeting of the Slogan Committee on May 5th should produce a design and slogan eminently suited for the society's purpose.

The great mass of ideas and suggestions made at the recent conference in New York for the active work of the society will give ample scope for the work of the Committee on Plans, which has been called to meet May 6th to evolve with the co-operation of the Executive Committee, the complete plans for carrying out the work of the society, which will be started when the minimum of $200,000 has been subscribed for this purpose.

The comprehensive plan will be presented to the membership at the annual meeting of the society, which in all probability will be held in Chicago the week prior to the annual convention of the National Electric Light Association. Plans will be presented to the industry at large in a publication which will be distributed shortly after the meeting.

The membership of the society is making a rapid increase and the expectation is that at the annual meeting in Chicago, an especially representative number of the men in the industry will be present.

The big broad scope on which the society's plans are to be organized should effect a great increase in the uses of electricity, in which practically every individual interest engaged in the industry will profit, so that a very complete co-operation of the various interests in the industry is expected, both in the development of the plans and in the subscriptions from members.

FINANCIAL NOTES.

The Pacific Light & Power Corporation of Los Angeles has authorized an issue of $5,000,000 one year, 6 per cent, secured gold notes, of which $2,500,000 is now being offered at par and accrued interest. They are due May 1, 1914, principal and interest being guaranteed by H. E. Huntington. This issue will be used to provide funds for the completion of the two new power plants now under construction at Big Creek, Cal., 240 miles of transmission lines to Los Angeles, etc. The additional funds are required because it was decided, owing to the growing demand for power, to construct plants of 67,000 horsepower initial capacity, an increase of 25 per cent over the originally contemplated 53,600 horsepower capacity, for which $10,000,000 first and refunding 5 per cent bonds have previously been sold. For the first two months of this year the gains over the corresponding months of last year are as follows:

	1913.	1912.	Pct.
Gross earnings	$434,204	$393,822	10.2
Operating expenses, taxes	248,990	236,336	5.3
Net earnings	$185,214	$157,486	17.6
Other income	19,482	3,893	400.4
Total income	$204,696	$161,379	26.8
Bond and other interest	78,603	87,894	†10.5
Balance	$126,093	$73,485	71.5

†Decrease.

The foregoing gross earnings for 1913 show an increase of 17.3 per cent over the corresponding period in 1911.

The item of bond interest does not include the charge on the $10,000,000 first and refunding 5s issued against the construction of the Big Creek plant. However, should the interest on the first and refunding 5s have been included, this statement would show a substantial margin over such requirements.

The California Railway & Power Company, which controls the United Railroads of San Francisco, has prepared its balance sheet as of March 31, 1913, as follows:

ASSETS.

Securities owned	$47,729,670
Notes receivable—United Railways of San Francisco	2,000,000
Cash and accounts receivable	190,779
Interest accrued	38,888
Deferred charges	9,323
Total	$49,968,662

LIABILITIES.

Prior preference stock	$3,000,000
Preferred stock	6,874,400
Common stock	40,000,000
Dividend on prior preferred stock, payable April 1, 1913	56,147
Profit and loss—surplus	38,114
Total	$49,968,662

TRADE NOTES.

The Safety Insulated Wire & Cable Company have closed a five-year contract with the Pacific Light & Power Corporation of Los Angeles for all underground cable to be installed.

Hunt, Mirk & Company, have closed a contract with the Mt. Whitney Power Company for a 5000 k.v.a. Westinghouse turbo-generator unit to be installed in the steam plant at Visalia.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

EXAMINATION FOR DEPUTY INSPECTOR OF ELECTRICITY.[1]

Electrical Wiring and Apparatus.

1. What kind of a current is required for series lighting system where no provision has been made for maintaining the circuit around the lamps?

2. How much more heat is produced by a current of 10 amperes than by a current of 5 amperes, both currents flowing through coils of the same length and size of copper wire?

3. What will be the drop of potential in a circuit of No. 14 copper wire 280 ft. long supplying nine lamps requiring 4.5 amperes? (Give work.)

4. (a) Name six alternating current systems of distribution. (b) Show by diagram a three-wire, 2-phase, and a four-wire, 2-phase, lighting system complete with necessary fuses and switches.

5. A single-phase circuit carries a load of 58 amperes, the power factor is 0.95, and the distance is 60 ft. What size of wire should be installed if a drop of potential of 3 volts is to be allowed?

6. Why is it desirable to have a starting box for a shunt wound motor that will never break the circuit?

7. (a) What is the object of an Automatic Starting Box? (b) How should the rheostats in series with the shunt coils of a dynamo be arranged?

8. (a) What is necessary to determine the proper size of wire for alternating current motors that are rated in horsepower? (b) What are the code requirements for the support of wires in conduit vertical risers?

9. A three-phase induction motor rated at 40 amperes per terminal on 220 volts is to be installed at a distance of 80 ft. from switchboard. The motor is slightly overloaded and the power factor is 0.85. A drop of 4 volts is allowed. What size of rubber covered wire will be necessary to comply with the code requirements?

10. (a) Why does the moving of the arm of a rheostat raise or lower the voltage of a compound wound or shunt wound dynamo? (b) Will reversing the shunt coil connection prevent a dynamo from generating? (c) For what two purposes is wire used on a dynamo or motor?

Electricity.

1. (a) In what two ways is electricity distributed for commercial use? (b) Name two principal ways that electricity is usually generated.

2. a) Into how many principal classes can electric circuits be divided? (State fully and show by diagram.) b) What is the difference between a metallic circuit and an earth circuit? (Show by diagram.)

3. (a) What is dynamic electricity? (b) Does electricity flow in a current like water, or a fluid? (c) What determines the power of an electric current? (d) Upon what does the power of an electric current depend?

4. (a) What does the term "Potential" mean as applied to electricity? (b) What does the term "Electromotive Force" signify?

5. (a) Does the flow of an electric current along a wire always produce heat? (b) Is the heat produced by the passage of an electric current always a loss of energy?

6. (a) What is an induction coil, and for what purposes is it used? (b) Show by diagram the circuit of a typical induction coil outfit.

7. What does an ampere-hour represent? (Give work.)

8. (a) What is an inductive circuit? (b) What is a magnetic circuit? (c) What is a Volt-Ampere?

9. Name three classes of dynamo-electric machines and for what use the machines are for.

10. What are the three essential parts of a constant potential transformer?

Practical Questions.

1. (a) Which is the more desirable for electric lighting and power work: constant pressure current, or constant current with varying pressure? (b) Can a three-wire system be used on any other system than a constant potential system?

2. (a) Upon what effect of the electric current does a circuit breaker depend for its action? (b) What usually occurs when a circuit carrying a heavy current is broken? (c) What is a reverse circuit breaker? (d) Where is such a breaker generally used?

3. What class of places is considered as being extra hazardous by the city electrical inspection department in which waterproof sockets must be installed? Name six such places, and the requirements of the inspection department for such installation.

4. (a) Name five code requirements for the installation of high voltage (550 v.) motors in buildings. (b) What are the code requirements for the tapping of wires at 3-way and gang switches? (c) Where two or more direct current motors are supplied from one service or from the same feeders, how would you determine the proper size of wire for service and feeders? (d) Where two or more alternating current motors are supplied from one service or from the same feeders, how would you determine the proper size of wire for service and feeders?

5. (a) What is the essential requirement of the Portland Railway Light & Power Company before connecting to main service? (b) Why is the lower limit of carrying capacity specified by the code for rubber-covered wires?

6. (a) Why does the speed of a motor increase as the field coils get warm? (b) What is the difference between the counter electromotive force produced in a motor, and the e.m.f. produced in a dynamo? (c) Why is it that the Edison three-wire system is economical of copper?

7. How many amperes equal one horsepower on a 110-volt circuit? On a 220-volt circuit? On a 500-volt circuit? On a 1000-volt circuit? On a 10,000-volt circuit?

8. If you were an electrical inspector, sent to inspect an installation of electric wiring in a building and found that there were some minor things that did not strictly conform to the code requirements, but which were mechanically all right and did not add to the fire and life hazard risk by not so complying with the code, would you pass the installation as being O. K.? (State fully.)

9. Show by diagram a method of connecting lamps in a circuit so as to get even voltage at lamps even with great drop in the line.

10. (a) What is a horizontally wound armature? (b) What is a vertically wound armature?

[1]Given by Civil Service Commission of Portland, Oregon, April 17, 1913.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Railroad Commission has issued an order effective June 1 requiring all public utility companies under its jurisdiction, including common carriers, to furnish the following information:

1. An itemized statement of new issues of stock during the years 1911 and 1912.
2. The net cash realized from each certificate so issued.
3. The purpose to which the money so raised was devoted.
4. An itemized statement of bonds issued during the same years.
5. The cash realized from the sale of such bonds.
6. The purpose to which the money so raised was devoted.
7. Notes issued between January 1 ,1912, and June 1, 1913.
8. The cash or other considerations realized from such issues of notes.
9. The purpose to which the funds raised by issuance of such notes was devoted.

The Union Home Telephone & Telegraph Company, operating in southern California, has made application for authority to issue bonds in the sum of $161,000 to meet maturing obligations.

The railroad commission has rendered a supplemental opinion following its original order by which it established the basis upon which utilities might deviate from the published schedule of rates. All utilities shall file a list of their deviations, with the reason for such deviations, and shall indicate which deviations they desire to retain and which to eliminate. The commission will then determine each particular case. The rates which were in effect before the commission assumed jurisdiction shall remain in effect until the commission authorizes a change. The commission sets forth that in removing discriminations the question is always open whether such discrimination shall be moved by raising one rate or by lowering another. To that end the commission proposes that each specific case be treated upon its merits and that no changes which could have the effect of increasing rates be made arbitrarily by the utilities.

Frank F. Cady and Rilla E. Cady asked permission to issue notes secured by mortgage on a water system for $10,000, the Honey Lake Valley Mutual Telephone Association to issue promissory notes for $10,000 and the Beaumont Gas & Power Company to issue notes and other evidences of indebtedness for $5000.

Authority has been granted to the Sacramento Natural Gas Company to issue bonds to the amount of $193,000. The bonds are to be used to pay existing obligations and for the following new construction: Gas holder, $35,000; site for gas holder, $6000; meters, $5400; extensions of mains and service pipes, $95,000; new gas well, $15,000.

A certificate of public convenience and necessity has been granted to the Midway Gas Company to conduct natural gas from the fields in Kern county and to distribute it in Los Angeles and vicinity. A previous application by the Midway Gas Company was denied on the ground, first, that the company was organized so as to create a monopoly whose rates could not be regulated, and, second, that it proposed to take gas from the territory in dispute between the Southern Pacific Company and the United States government without providing any protection for the rights of the government.

The Southern California Edison Company has applied to the Railroad Commission for authority to sell 30,000 shares of its common capital stock at a total par value of $3,000,000. The company desires to use the money to redeem outstanding debentures, $332,000, to discharge floating debt, $1,105,000, and the balance to be used for additions and betterments of the plant.

The Southern Sierra Power Company has applied to the Railroad Commission for a certificate of public convenience and necessity to operate under franchise in Kern County.

D. C. Gillen and the Pacific Gas and Electric Company have joined in the application to the Railroad Commission asking that the former be given authority to sell to the latter his electric system in the city of Colusa and vicinity for $12,000.

The Railroad Commission rendered a decision denying the application of the New Freeport Telephone and Telegraph Company for permission to raise its local rates. The company operates in a territory near Sacramento. Investigation by the Commission enabled the applicant to obtain modified switching arrangements with the Pacific Telephone and Telegraph Company, which will serve to increase materially its revenue. With this adjustment the increase in rates was found unnecessary.

Adhering to a previously announced policy that where a utility is serving a given field adequately a second utility would not be authorized to enter the field, the Commission on the 29th granted authority to the Oro Electric Corporation to serve a portion of San Joaquin County, but withholds from the corporation for the present authority to enter and compete in the city of Stockton.

Under the terms of the decision, the Western States Gas and Electric Company, which now serves Stockton, is given ninety days within which to complete the reconstruction and unification of its system, to improve its service and to meet the rates proposed by the Oro Corporation. If at the end of that period the Western States shall have satisfied the Commission as to the adequacy of service and the reasonableness of its rates, the Oro Electric will be denied the right to enter Stockton, but if the Western States fails to convince the Commission of these essentials, the application of the Oro Corporation will be granted.

The Commission found that the Western States' service was not what it should be, but ascribed this, in part, to the fact that the company is reconstructing and unifying its system, and for that reason preferred to give it sufficient time to show what it could do. The Commission also, in reaching its conclusion, took into account the rates and service of the Oro Electric in territory it now serves, and declares that its rates are abnormally high, and that, although a promise to lower the rates had been given, the promise had not been fulfilled.

"We cannot," said the Commission, in the decision, "escape taking into account the past performanaces of the Oro Electric as an indication of how well it is liable to meet its promises in the future."

The specific territory the Oro Electric is permitted to serve is in San Joaquin County, from a point south of the right of way of the Santa Fe Railroad east of Bixler, through Stockton and Burnham to the easterly boundary of the county, except the city of Stockton, and also all portions of San Joaquin north of the right of way of the Santa Fe except incorporated cities and towns and a strip of territory a mile wide to the north and east of Stockton and the island territory in the western portion of the county.

The Commission points out that, while the effect of its previous decision regarding utilities seeking to enter fields already adequately served has been to bring about some improvement, the utilities are not yet living up to their duty to the public in non-competitive territory. It declares that in judging a utility under this rule, it will consider the utility's attitude in all of the territory it serves.

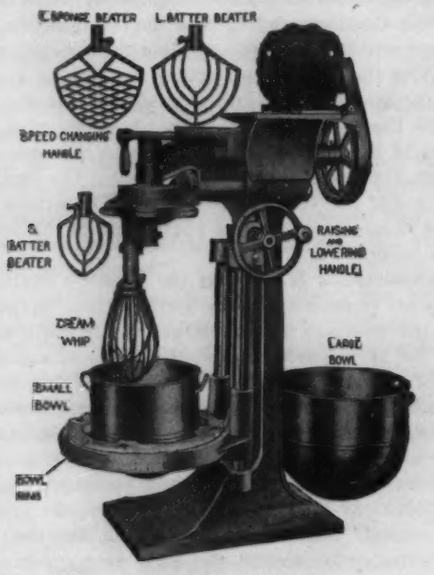
It further declares that the Oro Electric can furnish rates that it proposes in Stockton, but has apparently just shaded under the Western States' rates for the purpose of making a showing at the hearing, and criticises this practice, calling attention of utilities desiring to enter competitive territory to the fact that they will be judged by their willingness to do their best, and not merely to shade the rates of the existing utility.

INDUSTRIAL

MOTOR DRIVEN MIXER AND BEATER.

The use of machines driven by small individual electric motors has proved a great source of economy in bakeries, confectionery plants, hotels, and restaurants. These machines do their work much more rapidly than it can be done by hand, and produce better and more uniform results at an insignificant expense for current. Hence the cost of labor is greatly reduced; the work can be put through with less delays, and working conditions in the kitchen or bakery are greatly improved by reducing the number of people employed in it and lessening the amount of material standing around and spilled.

Motor driven machines of all kinds can be obtained; egg and cake beaters, dough mixers, dish washers, knife grinders, silverware polishers, vegetable parers, fruit pitters, etc. The beater and mixer illustrated herewith is a



Motor-Driven Mixer and Beater.

typical example of these time and labor saving devices, and gives an excellent idea of what can be accomplished by them.

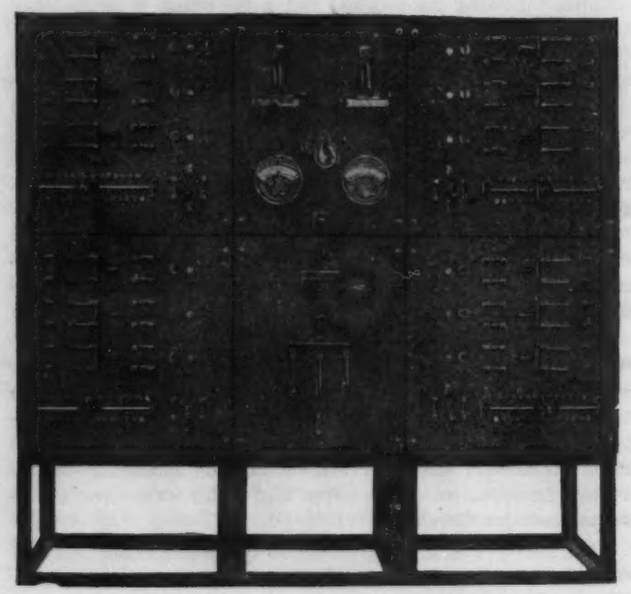
This machine is applicable to all classes of plain and fancy cake, biscuit, and egg work, fruit and other pie fillers, jams, jellies, sauces, dressings and other preparations that require mixing and mashing.

The beating bowl rests on a stand which can be raised to the beater by turning a handle. When the operation is completed, the bowl is lowered and another substituted. A variety of styles and sizes of paddles, such as beaters for sponge, batter, eggs, cream, fruit, pumpkin, cheese cakes, and potatoes can be supplied for the machine and since one can be quickly replaced by another, the operation of the machine can be made practically continuous regardless of the kind of work to be done.

The machine has three speeds, any one of which can be obtained by turning a handle without stopping the machine. The capacities of the bowls which are supplied with the machine are 30 and 80 quarts. Where the mixture to be beaten must be kept hot or ice cold, a water bath is supplied. The machines are made by the Read Machinery Company, York, Pa. Westinghouse motors are used to drive them.

CUTLER-HAMMER PANELS FOR CHARGING BAGGAGE TRUCKS.

The use of motor-driven trucks in factories, railroad stations and other places where baggage is handled has been found to be of considerable advantage. For the charging of the batteries of these trucks, the Cutler-Hammer Manufacturing Company Milwaukee has installed a number of charging equipments, one of which is shown in the accompanying illustration. This is installed in the North Station, Boston, of the American Express Company, and is designed to charge from one to twelve of the 12-cell trucks at one time. There are four charging rheostat panels, two each side of the center panel, and each of these is arranged for charging one truck alone, or two or three in series. The rheostats are of the slider type with resistance grids mounted in frames back of the panels. The double throw



Cutler-Hammer Battery-Charging Equipment for Charging Electric Baggage Trucks.

switches, above the rheostat contacts when thrown to the right connect the batteries of the two or three trucks in series, and when thrown to the left cut into the circuit a fixed block of resistance sufficient to absorb the voltage of the battery at maximum current.

The arrangement for charging in groups allows the most economical use of current while at the same time keeping the number of separate rheostats to a minimum and the price consistently low. One truck can be charged alone if necessary, but it is usually possible to put two or three on charge at the same time.

The center panel carries single pole circuit breakers for each of the outside wires of the 3-wire system, on which this equipment is installed, and the meters. In this particular case plug receptacles were placed on the panels with tell-tale lamps opposite each receptacle which indicate when a battery is plugged in for charging.

The Puget Sound Traction, Light & Power Company has purchased three electric trucks and one electric railway tower wagon. The company is going to push the electric vehicle business.

NEWS NOTES

INCORPORATIONS.

MASON, NEV.—Articles of incorporation of the Mason Valley Telegraph & Telephone Company have been filed preparatory to invading this field with a modern telephone system.

LAS VEGAS, N. M.—The Clear Creek Power Company has been organized at Wyoming to do business in New Mexico. The company will furnish water power, and is capitalized at $1,500,000. James C. Fitch is agent in the state of New Mexico, and will be located at Socorro.

ILLUMINATION.

RIDDLE, ORE.—J. B. Caples, Canyonville, will endeavor to secure a franchise for electric light and power here.

ARLINGTON, ORE.—The citizens of this city have voted bonds in the sum of $5000 for the purpose of installing an electric light plant.

CLOVERDALE, CAL.—The California Telephone & Light Company has applied for permission to purchase the electric light and power distribution system of the Cloverdale Light & Power Company, operating in Cloverdale and vicinity.

SACRAMENTO, CAL.—By the terms of a new ordinance effective July 1 of this year gas will be furnished to consumers of this city for 95c per 1000 cubic feet, a reduction of 5c on the rate charged for the past several years by the Pacific Gas & Electric Company and the Sacramento Natural Gas Company.

RAISIN CITY, CAL.—The San Joaquin Light & Power Company has a large force of men here setting poles for the electric wires from the substation at Caruthers. This will bring the electric lighting system to the homes of Raisin, and a number of farmers are also considering the installation of electric pumping plants.

PORTLAND, ORE.—The Pacific Fire Extinguisher Company have obtained the contract for ornamental lamp posts on the Union bridge. The city is calling for bids to install ornamental post lighting systems in the various parks. Councilman Menefee has succeeded in getting measures through the Council by which all the bridges across Sullivan's Gulch will be well lighted with cluster lights, including Union, Grand, East, Twelfth, East Twenty-first and East Twenty-eighth street bridges. The appropriations for the lighting of these bridges have been made.

TRANSMISSION.

ALMIRA, ORE.—The city has granted the Washington Water Power Company permission to string wire and poles for power and light and heat.

MARTINEZ, CAL.—The Great Western Power Company has applied for a blanket franchise covering the surveys of all the roads in Contra Costa county.

ALMIRA, WASH.—The council has granted a franchise to the Washington Water Power Company to string poles and wires for distribution of electricity in this city.

MONTREAL, CAN.—The directors of the Cedar Rapids Power Company let out work in connection with the new hydroelectric development amounting to $3,000,000, to Fraser, Brace & Co., of New York.

LOS ANGELES, CAL.—The Board of Public Utilities has accepted the bid of the Cresmer Manufacturing Company for the erection of a new transmission station in Arlington district, designed to receive current contracted for with the Southern Sierra Power Company.

CHEHALIS, WASH.—Manager H. C. Coffman of the Washington-Oregon Corporation, states that the company has appropriated $15,000 to be used in improving and enlarging the water plant. The reservoir will be rebuilt and enlarged, new main line pipes will be laid and gates installed.

EL PASO, TEXAS.—The West Texas Electric Company of Big Springs, Texas, has started work of making improvements on the plant. The building will be enlarged and additional machinery added. New poles are replacing old ones, and the system generally placed in good condition. Cost will be about $20,000.

ASTORIA, ORE.—The Pacific Power & Light Company has filed a petition with the county court asking for a franchise for extending its transmission lines to the west part of the county. From Astoria the line will be constructed to Warrenton, Hammond and Fort Stevens, from where it will be extended to Gearheart park.

GARDNERVILLE, NEV.—Great strides will be made in pump irrigation in this valley. The Truckee River Electric Company is building its power line up the river with its terminal point at Genoa where the company will furnish lights. The farmers below Genoa are arranging to install electric pumps to irrigate land that has never been cultivated.

VANCOUVER, WASH.—The big concrete power station, built by the Mount Hood Light & Power Company at a cost of $11,000 and sold to the Portland Railway Light & Power Company, is being moved to First and Washington streets. Several weeks will be required to move the 8000-ton building through the garrison, as much as 60 ft. having been made in one day.

SAN FRANCISCO, CAL.—The Great Western Power Company has applied to the railroad commission for a modification of its recent order authorizing an issue of $4,411,000 in bonds. The company asks that money heretofore authorized for new lines, substations and transformer sets to the amount of $92,562, be made available under a modified order for extensions in the Napa district, the Oakland district, the Petaluma district, the Island district and for minor purposes of general improvements.

OROVILLE, CAL.—With the completion of the Oro Electric Company's power line from Biggs to Oroville on April 24th connection was made with the Northern California Power Company, which has a contract with the Oro company to supply it 30,000 volts in Butte City for this line. The Northern California Power Company has two other contracts with the Oro company, both of which soon will become operative. One contract is for the delivery of 60,000 volts five miles north of Colusa to be used on the Stockton and Natomas line and the other is for the same voltage to be delivered near Chico for the Oro's Belden line. The latter line should be completed in three weeks, while the former will probably be ready for connection in three or four months.

TRANSPORTATION.

SAN FRANCISCO, CAL.—Four of the 65 cars ordered by the United Railroads have arrived from St. Louis. They were taken to the Geneva-avenue shops for equipment of electrical apparatus. Six more cars are expected within the week.

SAN FRANCISCO, CAL.—The board of public works awarded the contract for the railway track construction on Geary street, Thirty-third avenue, Balboa, Forty-fifth avenue, Cabrillo street, from Geary street, near Thirty-third avenue to

the great highway to the Healy-Tibbitts Construction Company, for $34,450.

LEWISTON, IDAHO.—The contract has been let by the Lewiston-Clarkston Valley Railway Company for the purchase of its substation equipment and electrical appliances for the first unit of the road. W. C. Campbell, advisory engineer in the railway department of the General Electric Company, secured the contract for the machinery.

COLUSA, CAL.—The trolley lines of the Northern Electric are ready for the entry of the first train into Colusa. The bridge at Meridian is practically completed and the laying of tracks between Meridian and Colusa will take less than a week for completion and in all probability the first train will enter Colusa in ten days.

EUREKA, CAL.—An electric railroad from Korbel to the Eel River valley section is the proposition being investigated by Richard H. Tingley, electrical engineer of a French syndicate, who is here in response to the invitation of the Humboldt promotion and development committee. Tingley represents capitalists who are developing the electric railroad business in several parts of the United States.

STOCKTON, CAL.—The Tidewater & Southern Railway has commenced the work of electrifying its line from this city to Modesto. Two carloads of poles have been received, and distributed for a considerable distance south of Stockton. Chief Engineer J. H. Wallace has assembled a construction crew of 40 men for the work of erecting the poles and stringing wires. A large portion of the material needed has already been delivered. Wallace believes that the overhead system will be completed in about 60 days.

MODESTO, CAL.—Announcement has been made that the Modesto Interurban Railway, now in operation between Modesto and Empire, on the Santa Fe, will be extended at once to Waterford, 13 miles east of Modesto. All of the rights of way have been secured and construction work will start at once. Surveys have also been made for the extension of the road to La Grange, on the Tuolumne River, 33 miles east of Modesto, as soon as the Waterford extension is completed.

SAN FRANCISCO, CAL.—The operation of Geary street cars to the ferry will be instituted about June 1, according to present plans of the municipal government, the United Railroads and F. Rolandi, the contractor who will extend the municipal line from its present terminus at Kearny and Geary streets to the United Railroads' tracks on Market street. It has developed that actual work on the extension legally cannot be instituted until an official canvass of the votes has been taken and the results made known. As soon as the official count is taken the city and the street railway corporation will file a stipulation with the Supreme Court asking for a dismissal of the present appeal concerning the trackage agreement now before the court.

TELEPHONE AND TELEGRAPH.

PENDLETON, ORE.—The council has granted a franchise to the Independent Telephone Company, Pilot Rock, to maintain poles and wires on all streets, except Main and Court.

SUMAS, WASH.—The contract for the telephone block on Garfield street, has been let to Mr. F. M. Smith, Lynden, and work has been started.

FALLON, NEV.—The city council has granted a franchise to construct, operate and maintain a telephone and telegraph system in the city of Fallon, to a municipal corporation of the state.

LOS ANGELES, CAL.—The Union Home Telephone & Telegraph Company, operating in Southern California, has applied to the commission or authority to issue $161,000 of bonds for the purpose of paying existing obligations.

CLOUDCROFT, N. M.—C. A. Redic, president of the James Canon Telephone Company, attended a meeting of stockholders held recently. It was voted at the meeting to purchase the necessary material and go ahead with the construction of the line, several of the stockholders already having poles along the road where the line will run. Practically all the farmers along the line for a distance of 20 miles are stockholders.

WATERWORKS.

WOODLAND, CAL.—It has been decided by the Board of Trustees that Woodland have a bond election soon to provide funds for enlarging and extending the water system, sewer system, and fire fighting facilities.

BELLINGHAM, WASH.—Definite plans for the route of the new intake for the city water system to be constructed at Lake Whatcom this summer, have been adopted by the city water board. Work is to begin as soon as possible.

VALLEJO, CAL.—The city of Vallejo is to purchase 500,000 gallons of water per day from Fred Jones, the Green Valley orchardist, delivery to be started as soon as he can lay the necessary pipe from the wells on his ranch to the municipal pumping station.

PETALUMA, CAL.—An ordinance was introduced providing for the voting of bonds to the amount of $375,000 for the purchase of the physical property of the Petaluma Power & Water Company. The special election will be called on June 10th.

CENTRALIA, WASH.—The Washington Oregon Corporation has appropriated $15,000 for the improvement in the water system at Chehalis, the money to be expended immediately. Water will be extended to those parts of the city not already covered by the service.

SAN BERNARDINO, CAL.—The Empire Water Company, in which a number of San Bernardino men are interested, is preparing to install an immense hydroelectric plant in Coyote Creek, in the San Bernardino mountains, and has made application to the state railroad commission for authority to issue bonds in the sum of $200,000.

WATTS, CAL.—Plans have been complete by Frank E. Lathrop, consulting engineer of Los Angeles, for the municipal water system for this city. At the last meeting of the council, arrangements were made for calling a bond election to vote bonds in the sum of $100,000, with which to provide for the installation of the water system, chemical engine for fire-fighting purposes, and electric fire-alarm system, covering the entire town.

SAN JACINTO, CAL.—Angelo Domanigoni has filed on 3000 inches of water in Tauquit creek, for irrigation. He will convey same to a power house 10 miles below the point of appropriation above the junction of south fork of San Jacinto River with the main stream of the San Jacinto River, and above the diversion dam of the Lake Hemet Water Company. Water and electric energy is to be carried to lands adjacent to the San Jacinto River below the city of San Jacinto.

RIVERSIDE, CAL.—A special election will be held May 19th, for the purpose of submitting to qualified voters the question of incurring a bonded indebtedness for acquisition and construction of domestic and irrigating water works, system, the same to comprise the systems of the Riverside Water Company, Riverside Artesia Water Company, and H. P. Kyes, and the same to be combined, extended and bettered according ta the report of Messrs. Burns & McDonnell, consulting engineers. The estimated cost of the improvement is $1,160,000.